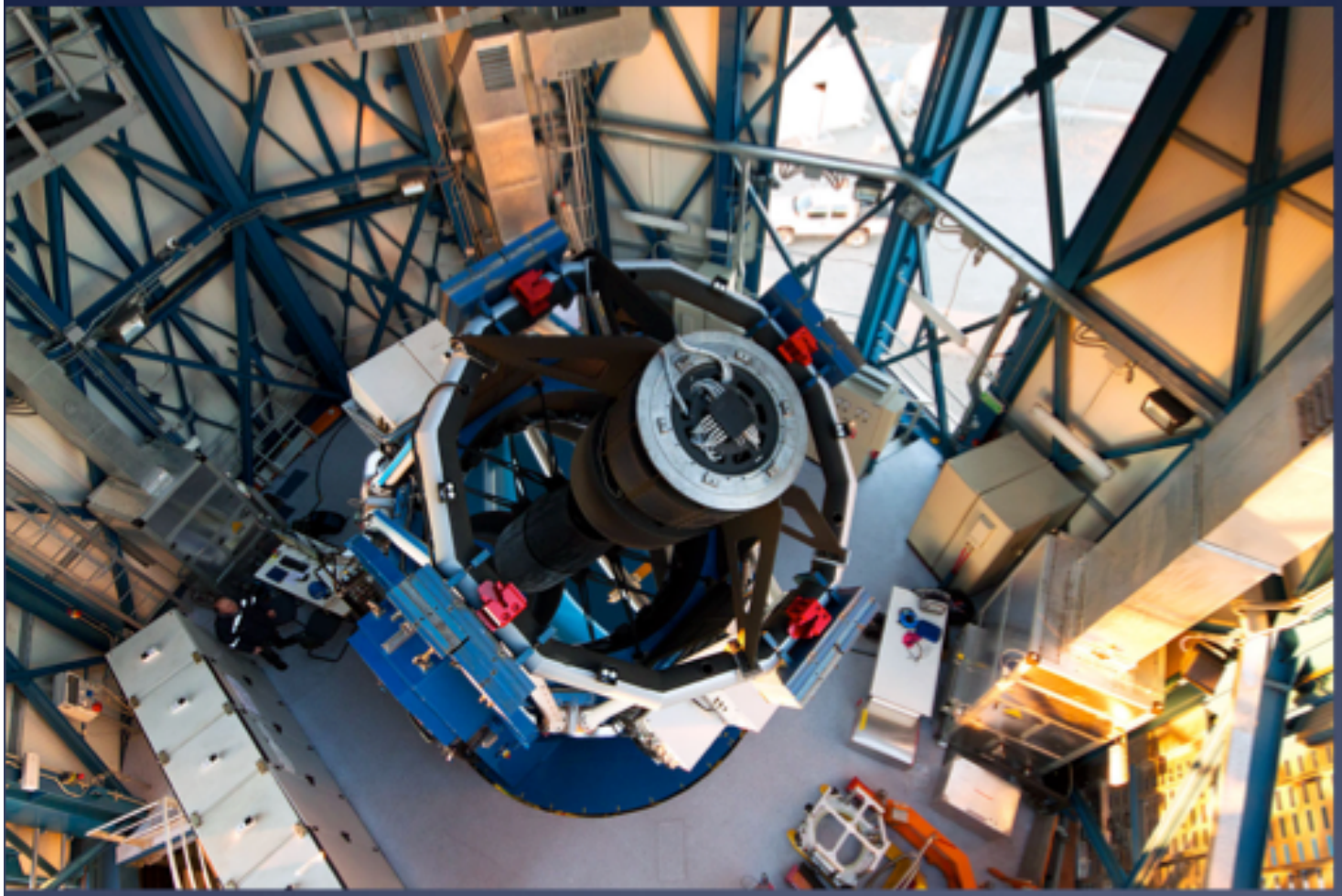
VST ATLAS: Overview + Status

T Shanks, B Chehade, R Mackenzie, N Metcalfe et al (Durham) + ESO + CASU(MJ Irwin et al) + WFAU(RG Mann et al)

VLT 2.6-m Survey Telescope

VST ATLAS overview

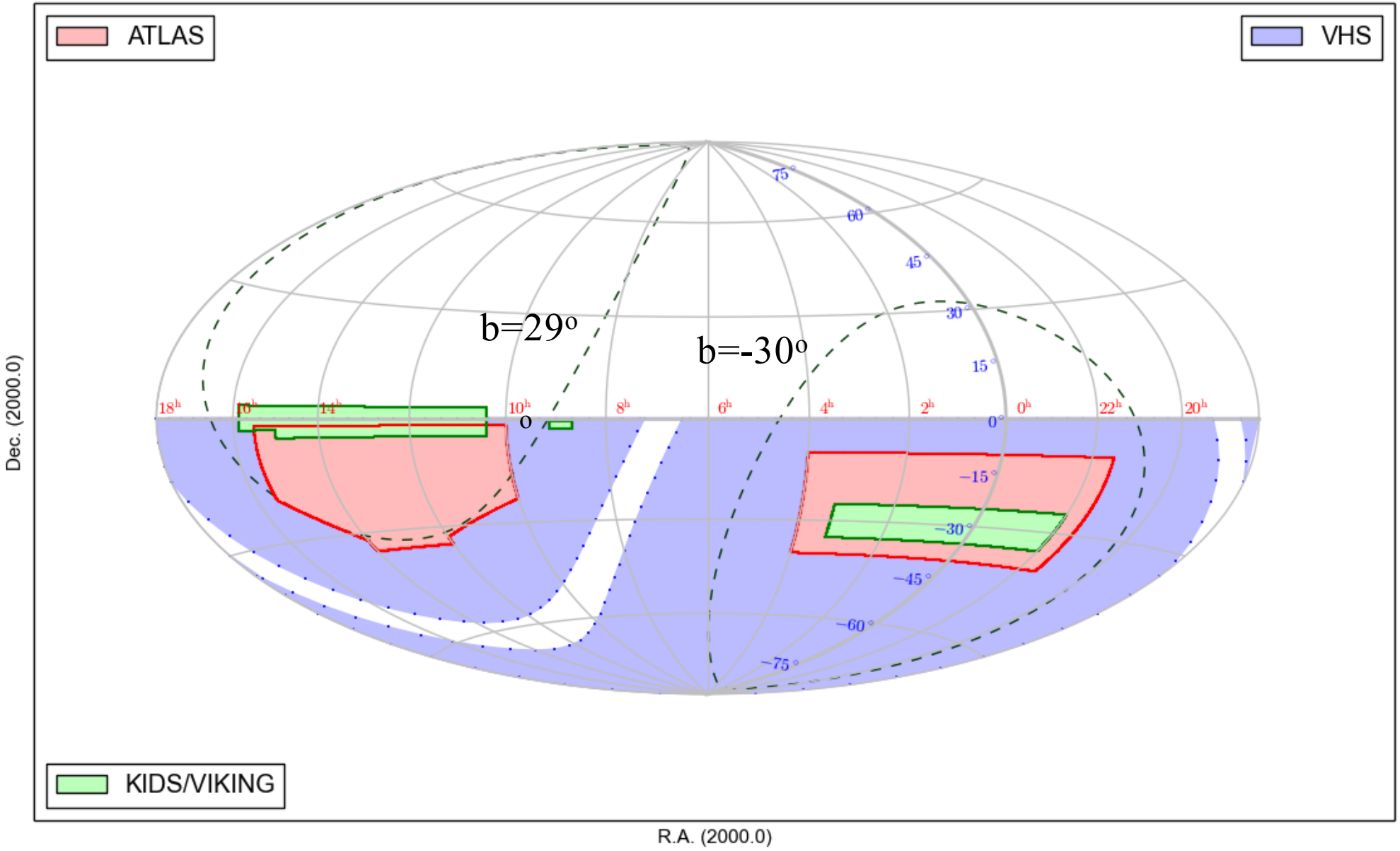


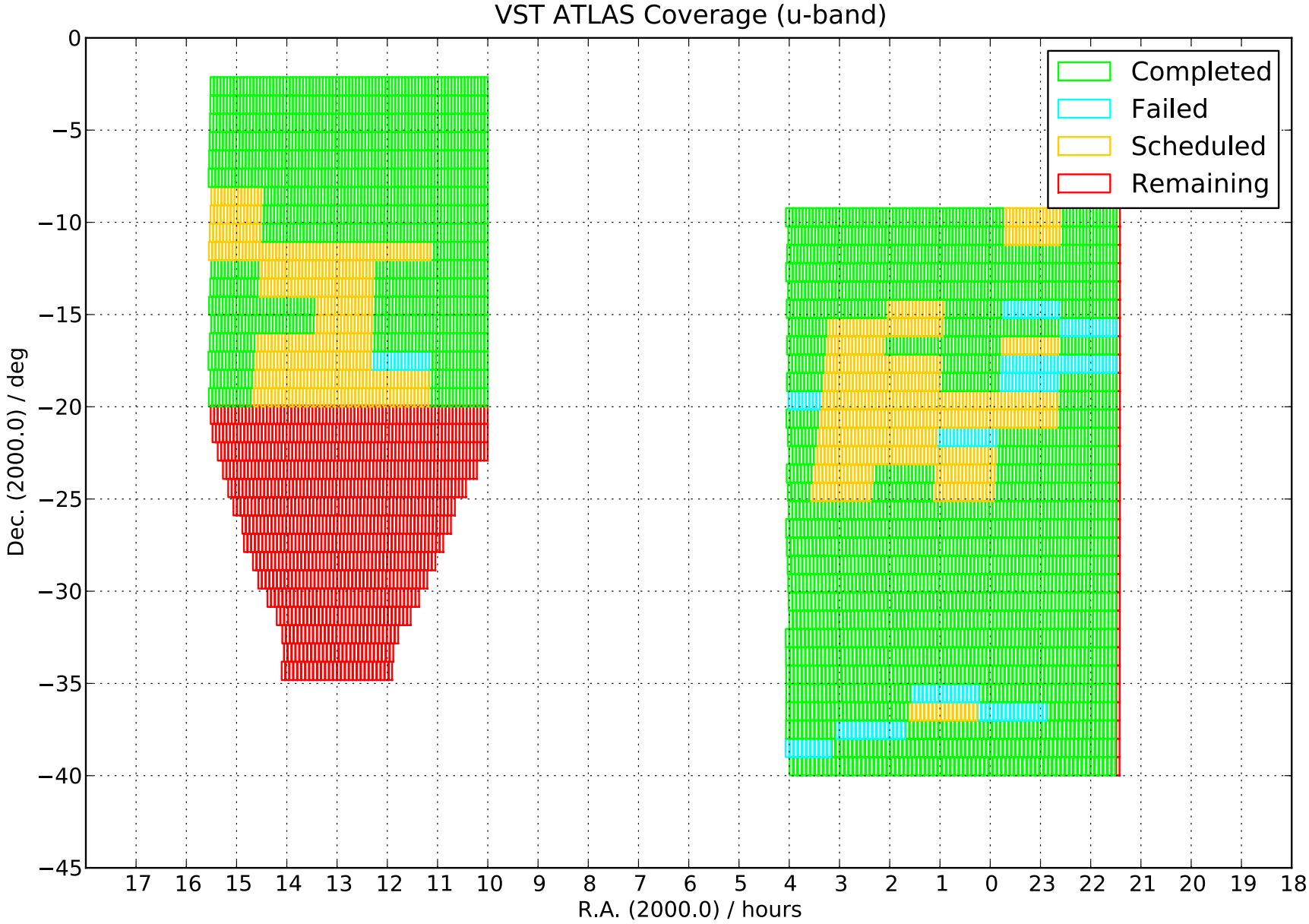
* "Southern Sloan" imaging survey
* ~5k square degrees
* ugriz bands
* VST camera -256k x0.2"x0.2"pixels
* → 1deg x 1deg field

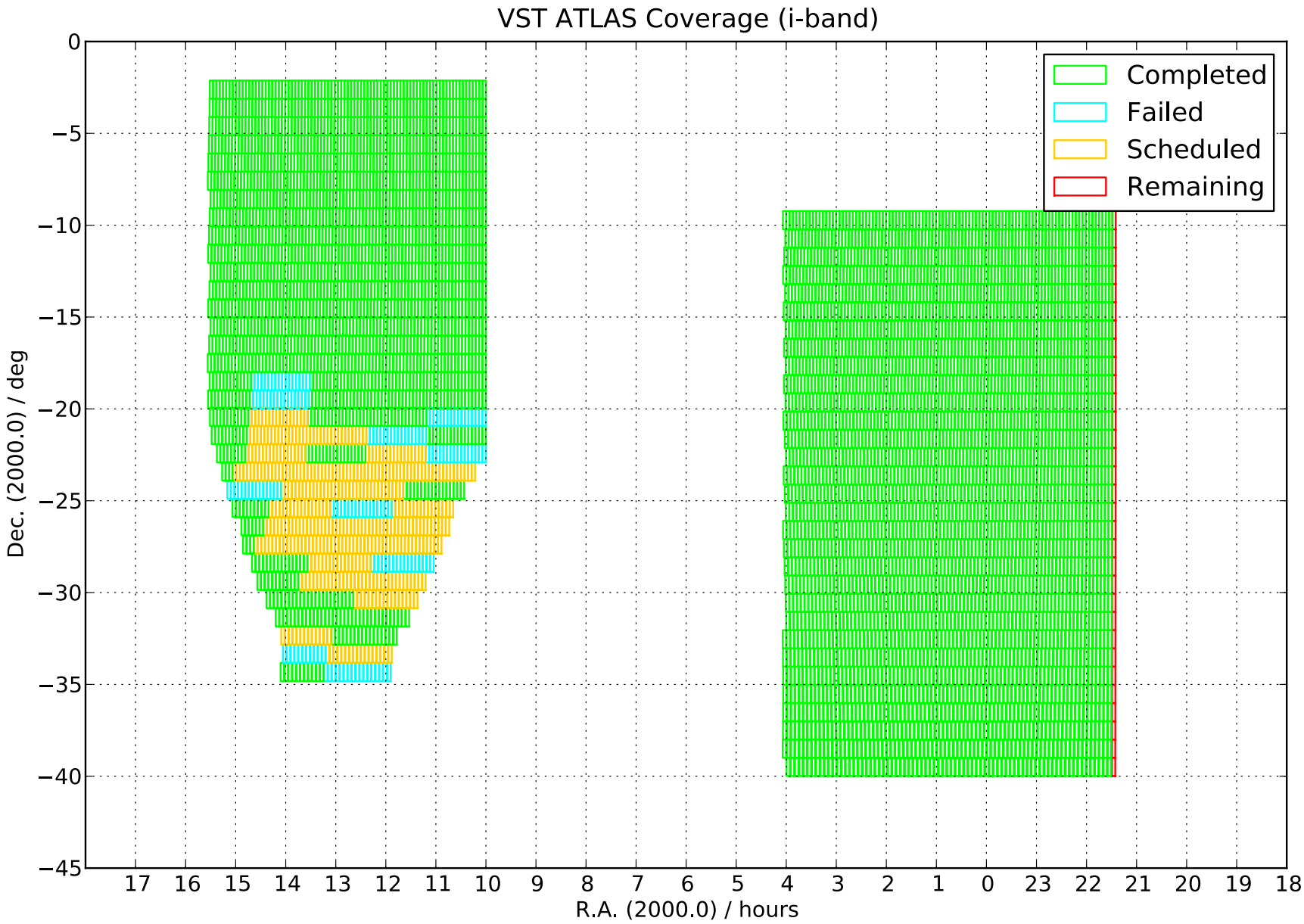
VST ATLAS Survey

- VST ATLAS (+VHS) → Southern SDSS in ugriz(+YJK from VHS)!
- Exposures u: 2x60s, g: 2x50s, riz: 2x45s – ugr (dark), iz (gray/bright)
- Chilean u extension (PI L. Infante) → doubles u exposure
- seeing<1."4 – better than SDSS – but see later!
- Footprint ~2500deg^2 in SGC and ~2200deg^2 in NGC
- Equivalent of ~4000deg^2 ugriz observed since September 2011
- ATLAS DR1 released 12 months ago contains ~1500deg^2 to 9/12
- ATLAS DR2 released last week ~2500 deg^2 to 9/13

ESO Survey Footprints




VST ATLAS Coverage (u-band)
Completed
Failed
Scheduled
Remaining
Dec. (2000.0) / deg
R.A. (2000.0) / hours
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 23 22 21 20 19 18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0
−5
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−15
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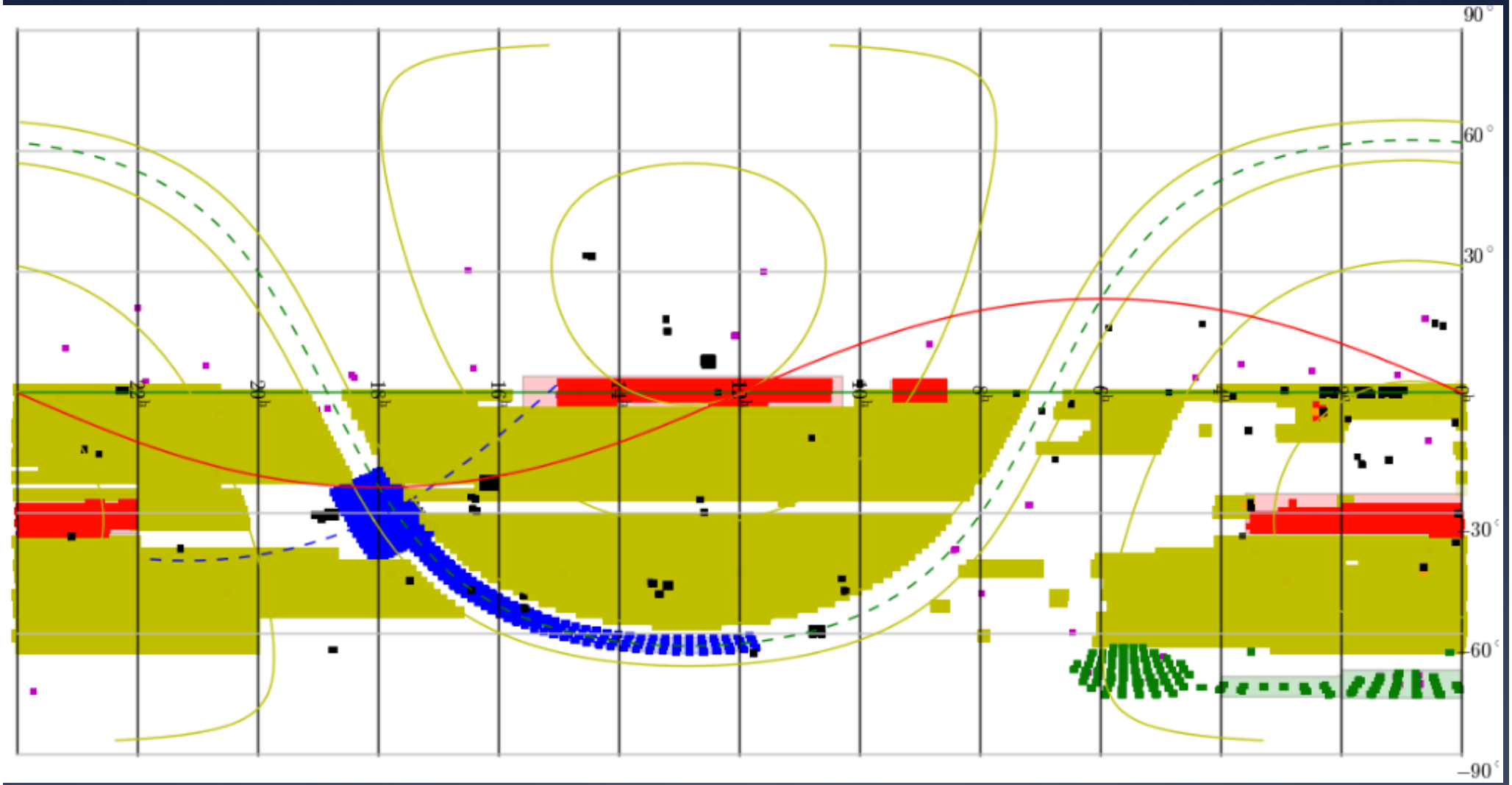
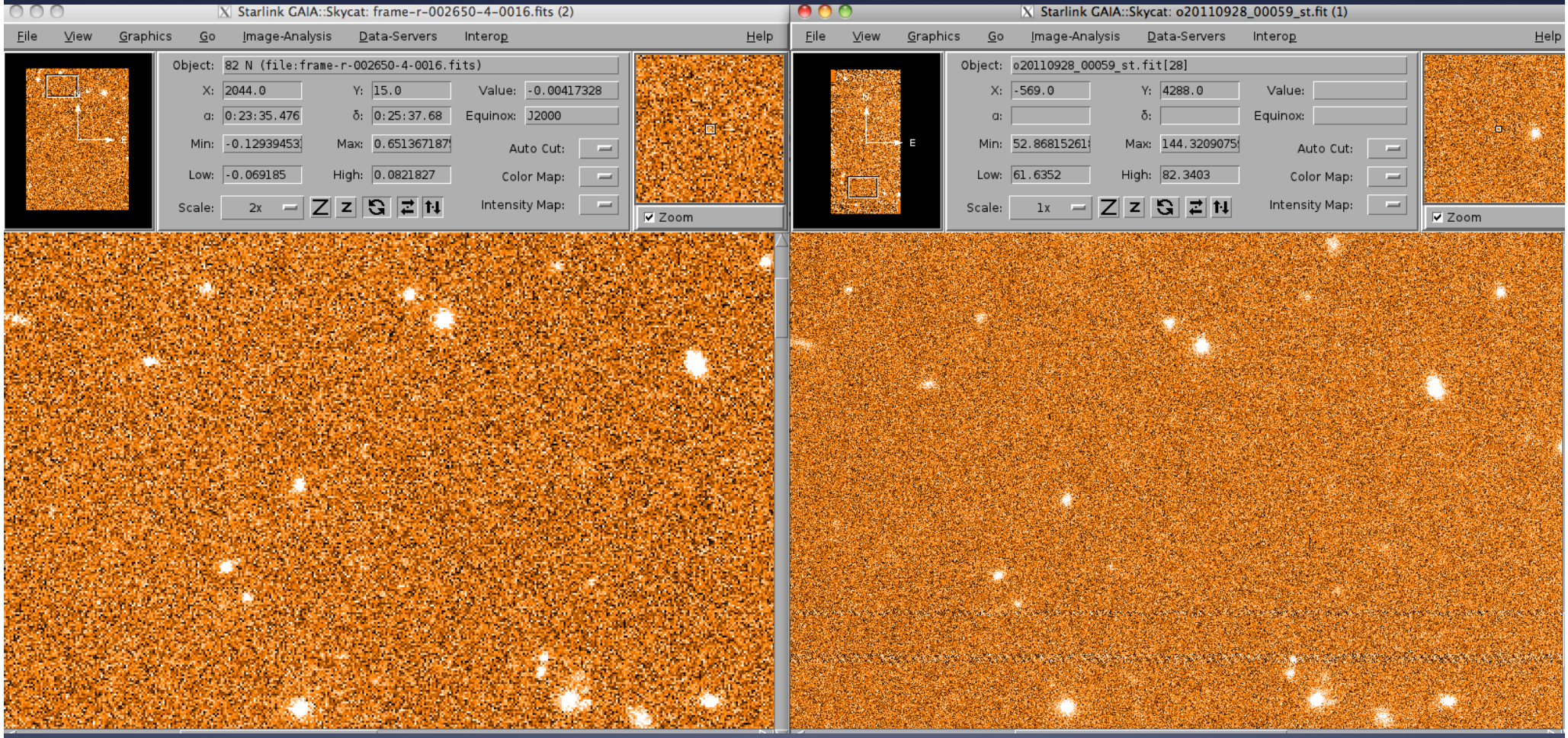
−45
17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 23 22 21 20 19 18

VHS+VIKING Progress



20/2/15

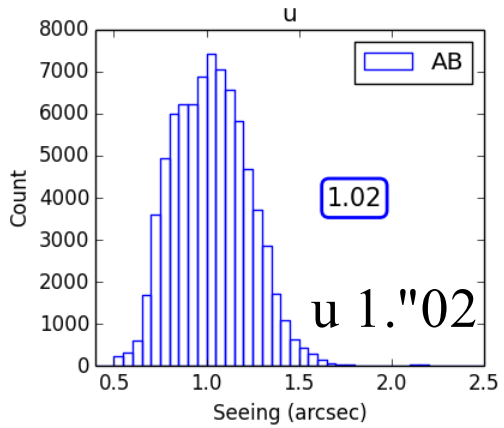
SDSS-ATLAS - r

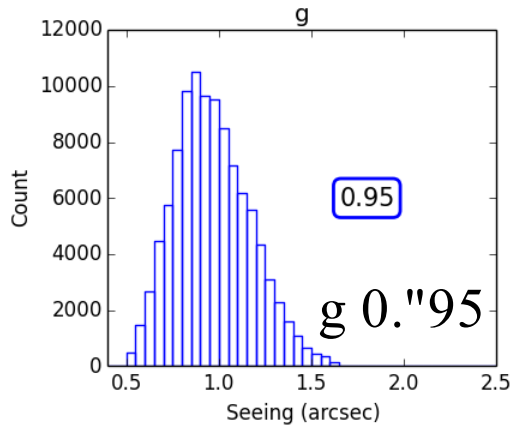


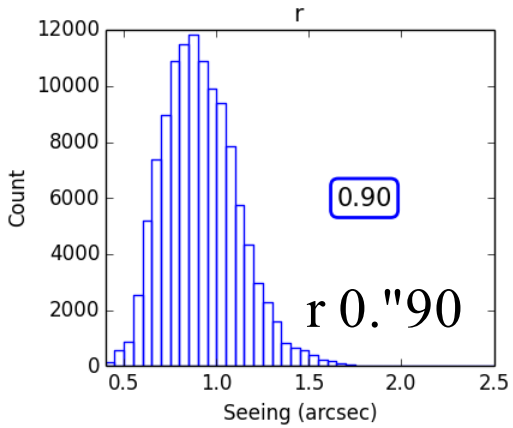
SDSS

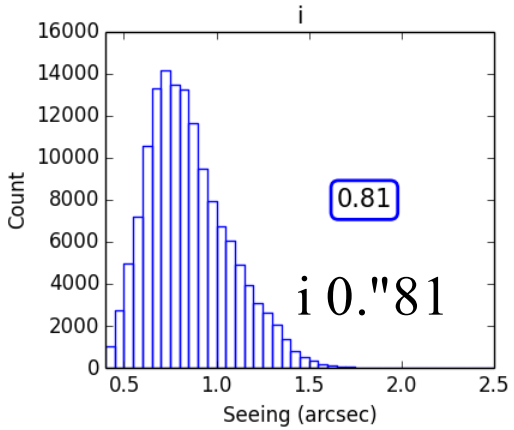
ATLAS

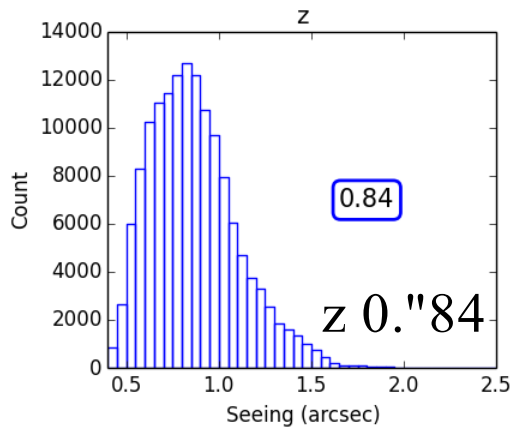
ATLAS seeing by band







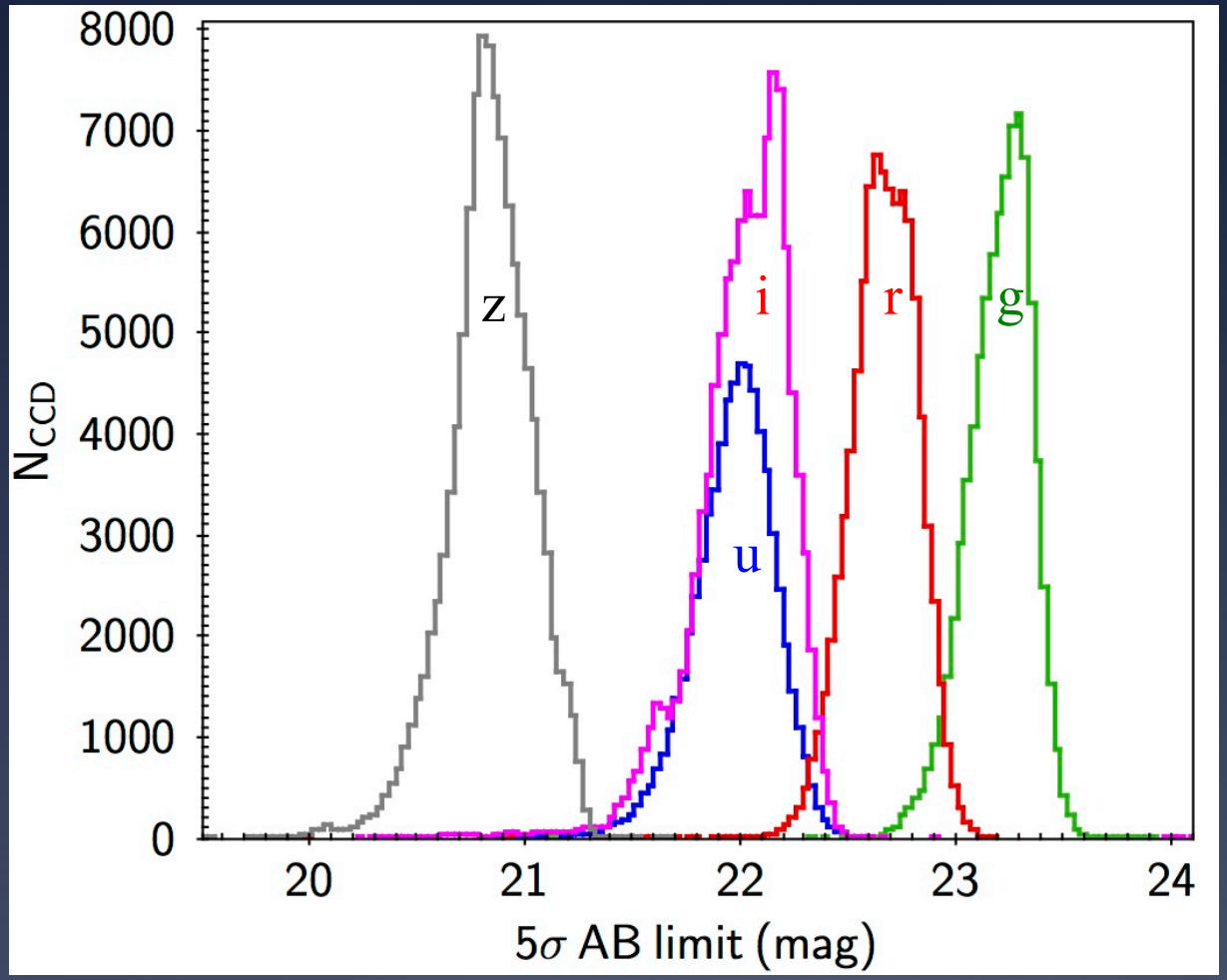




Median seeing
FWHM (arcsec)

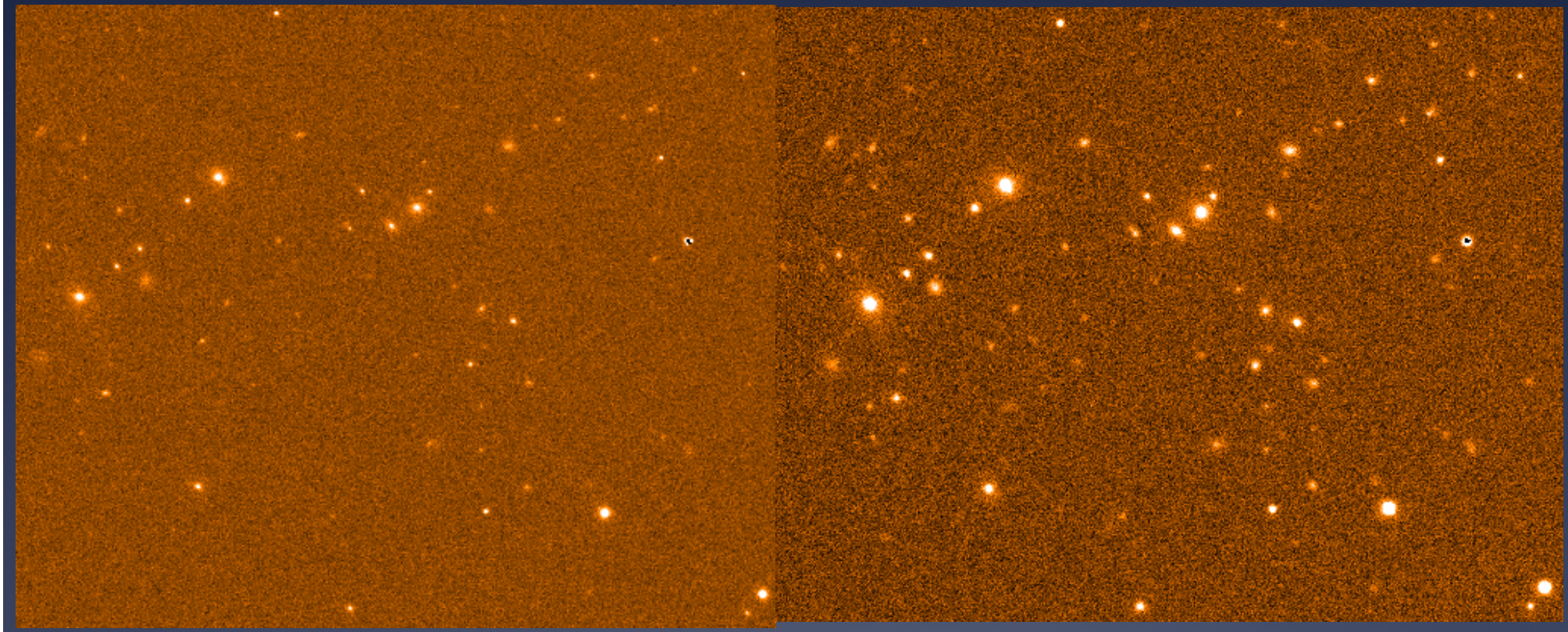
SDSS median seeing in range 1.″4-1.″2

ATLAS 5s point source limits



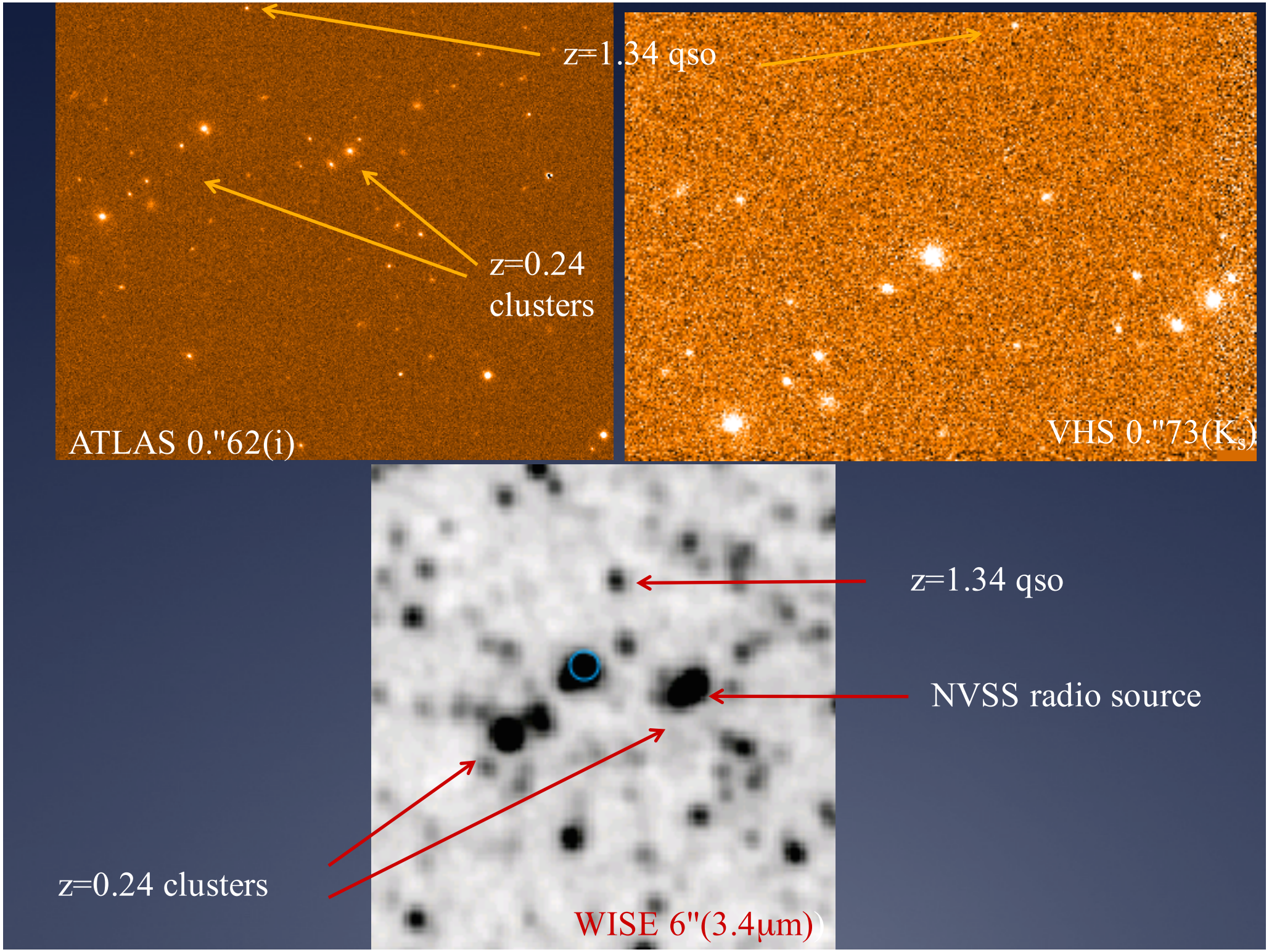
AB	u	g	r	i	z
ATLAS	21.99	23.14	22.67	21.99	20.87
SDSS	21.87	22.75	22.31	21.71	20.17

ATLAS v SDSS galaxy clusters

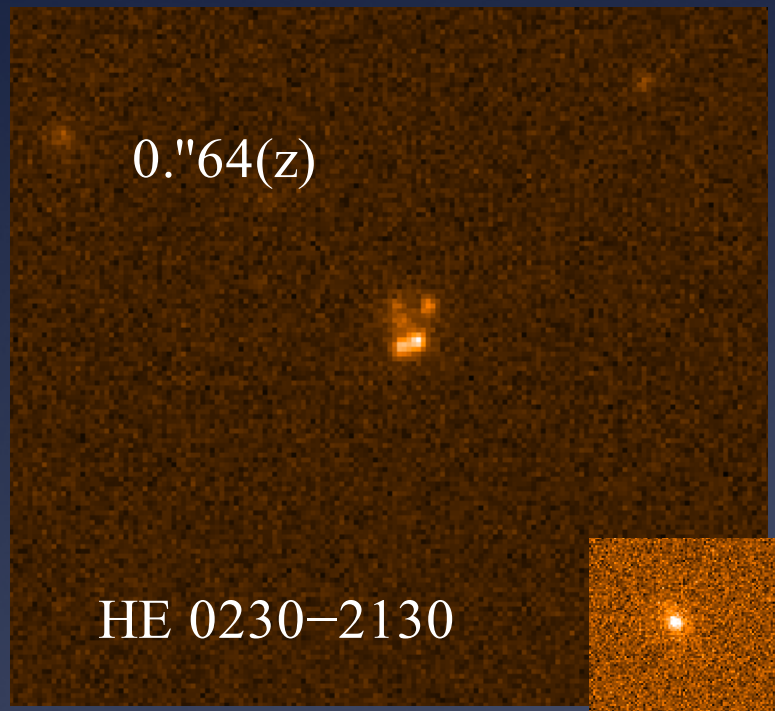


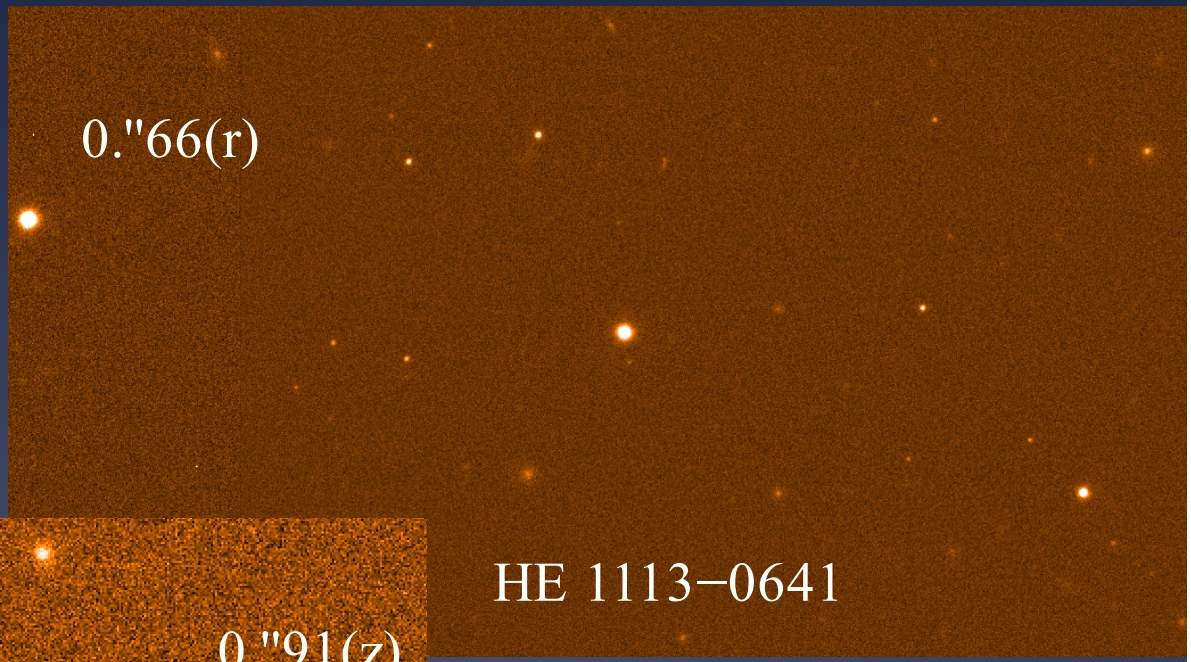
ATLAS i-band 0."62 seeing

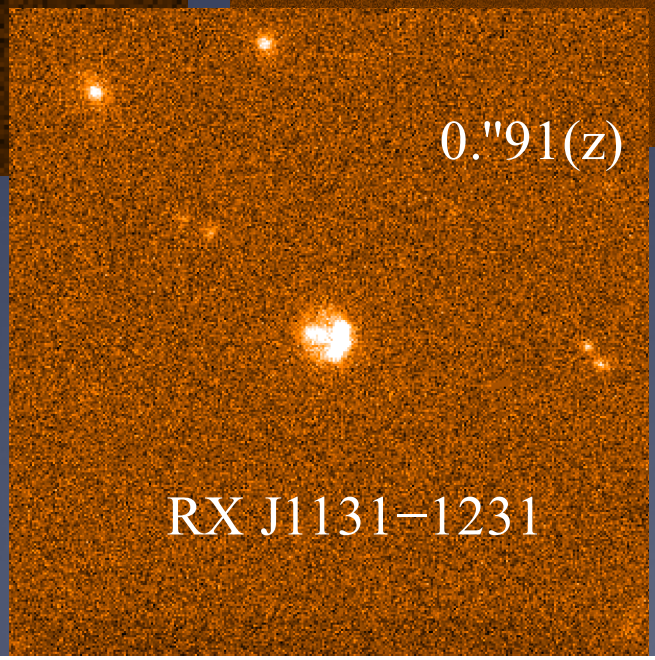
SDSS i band 1."20 seeing


z=1.34 qso
z=0.24
clusters
ATLAS 0."62(i)
VHS 0."73(K$_s$)
z=1.34 qso
NVSS radio source
z=0.24 clusters
WISE 6"(3.4μm)

Schechter's quadruple lenses

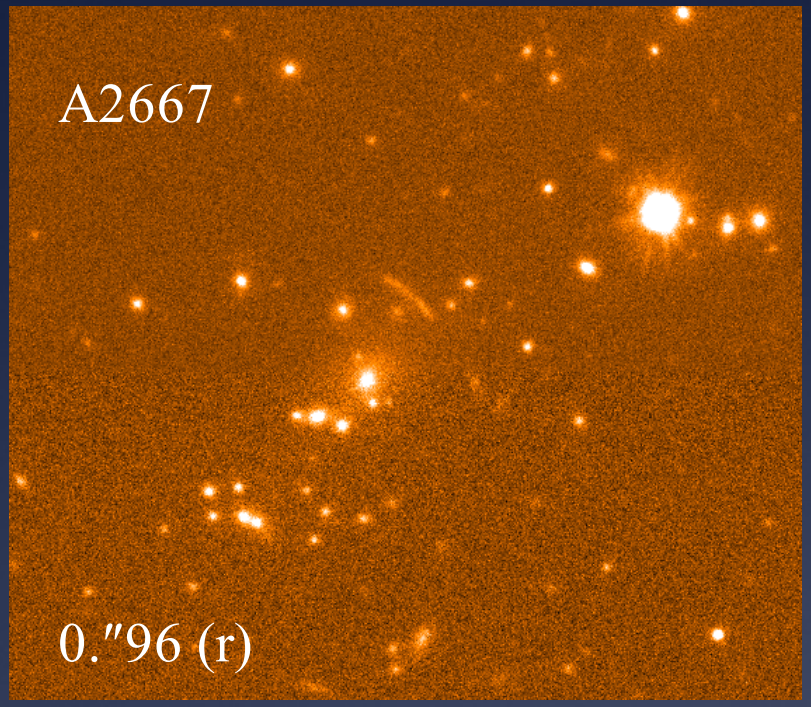


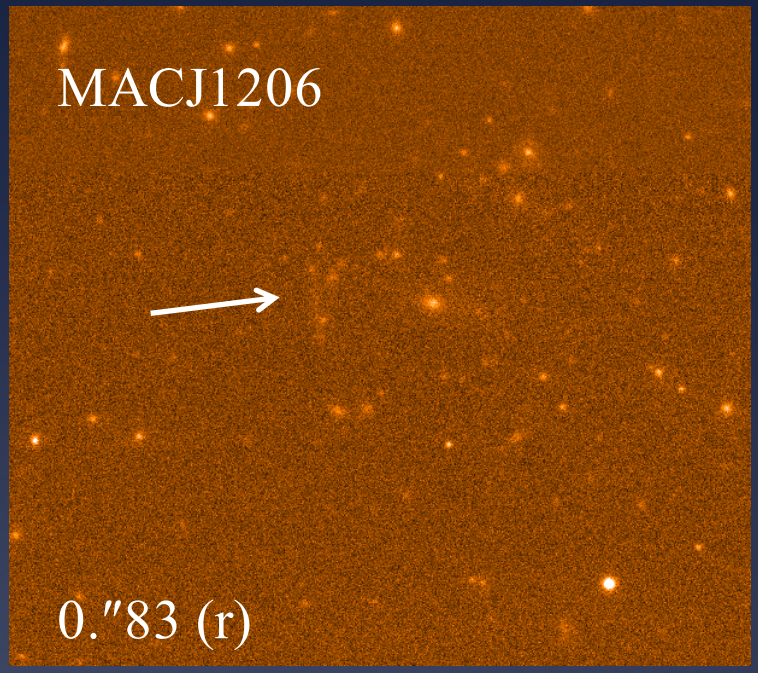


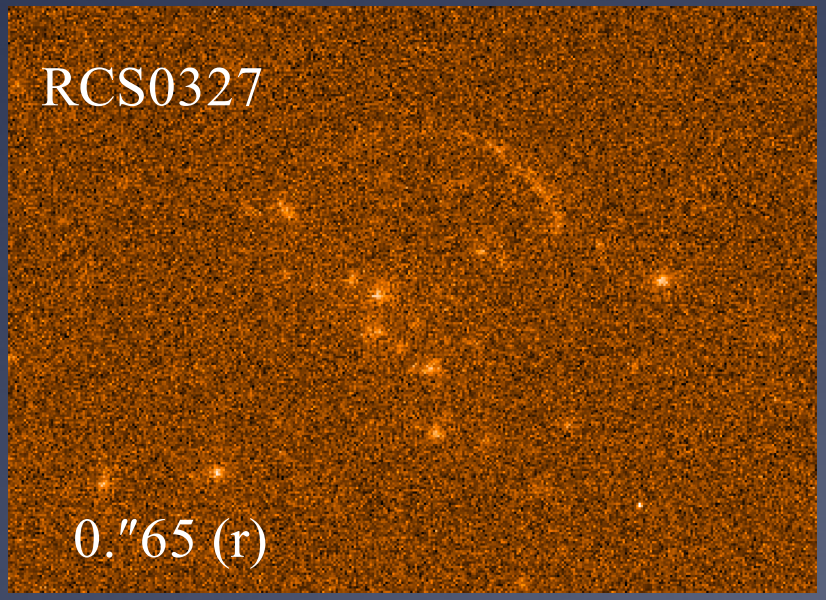


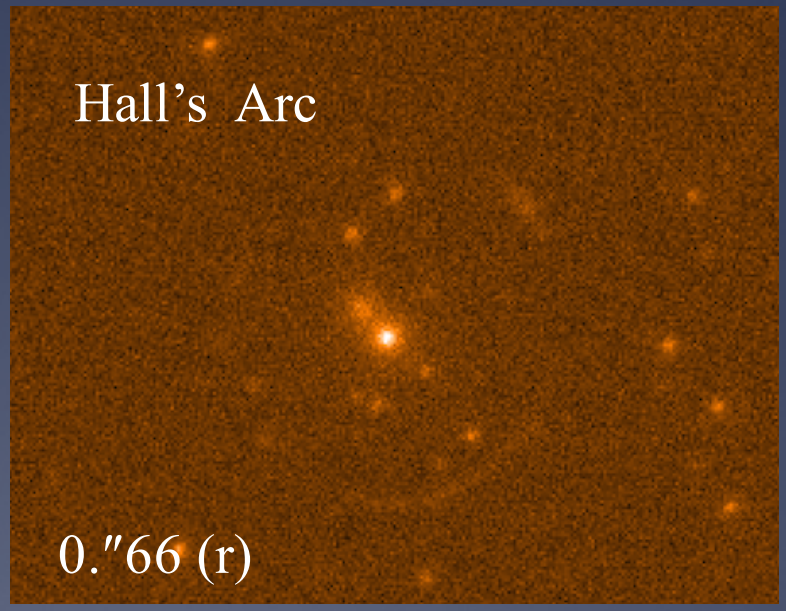
ATLAS images

ATLAS Arc Gallery

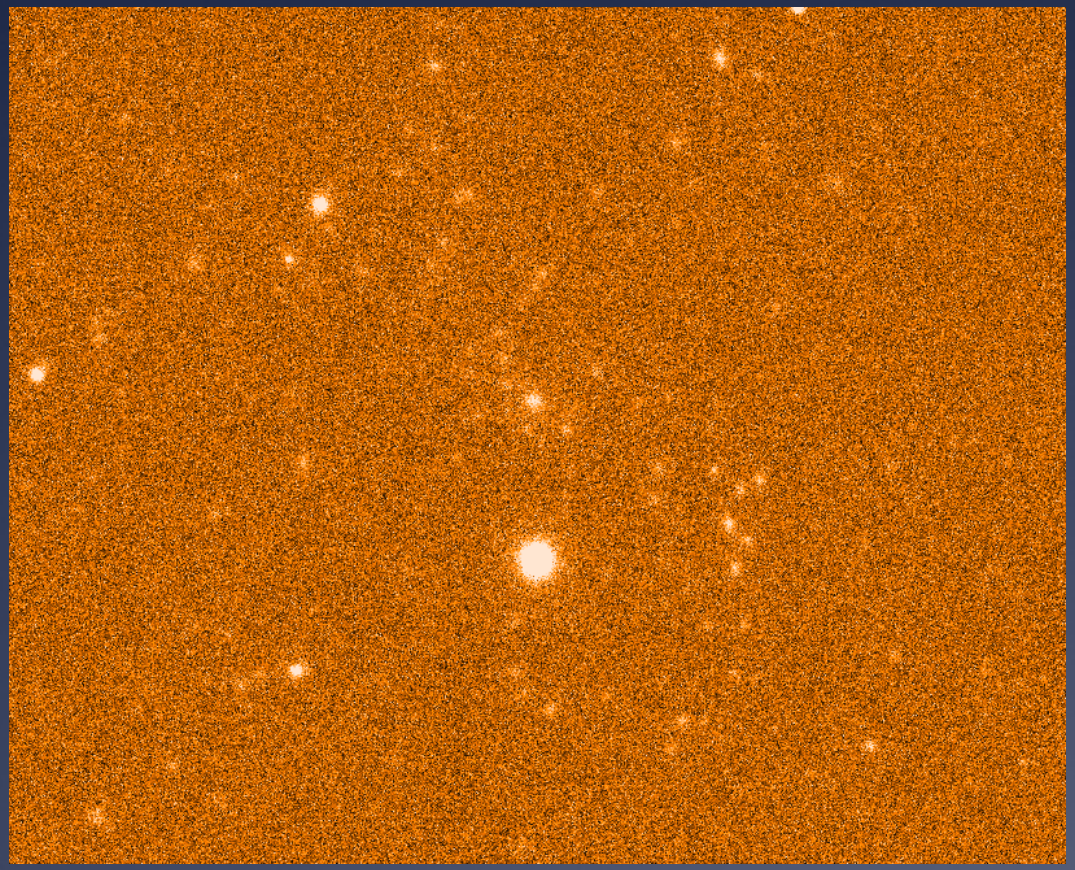




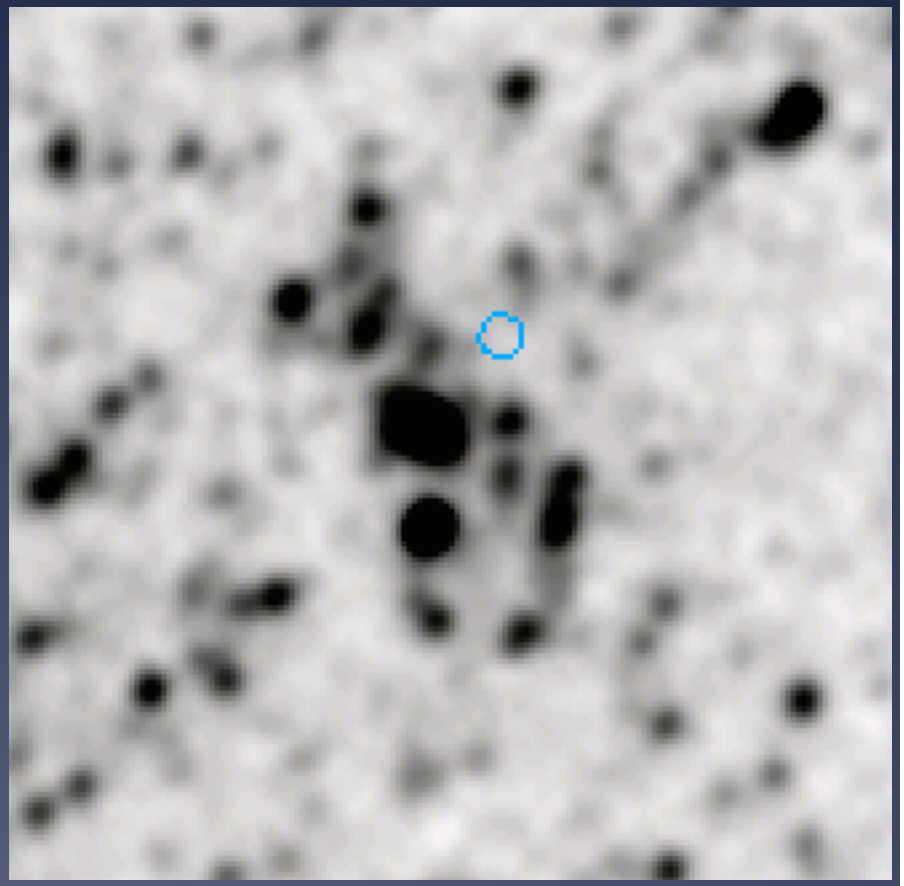




Planck SZ cluster at z=0.72



ATLAS i band

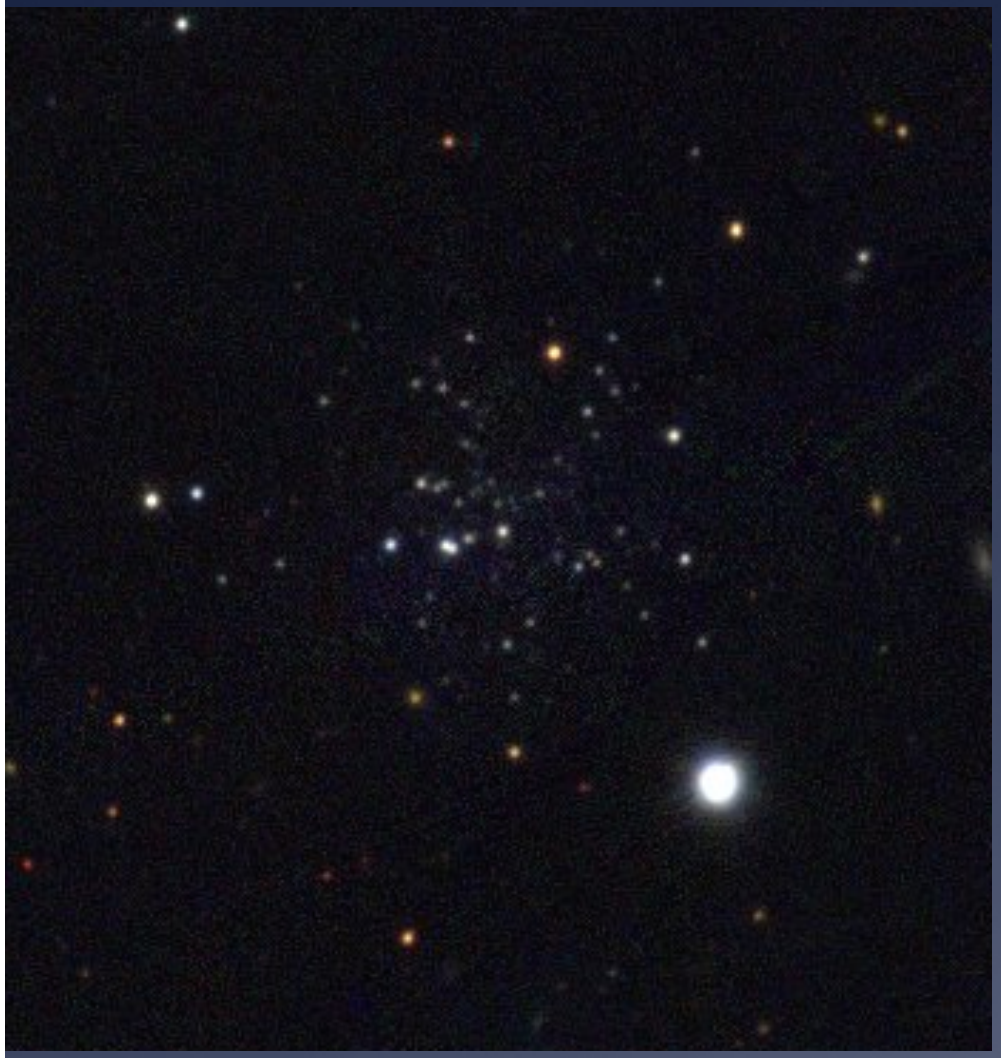


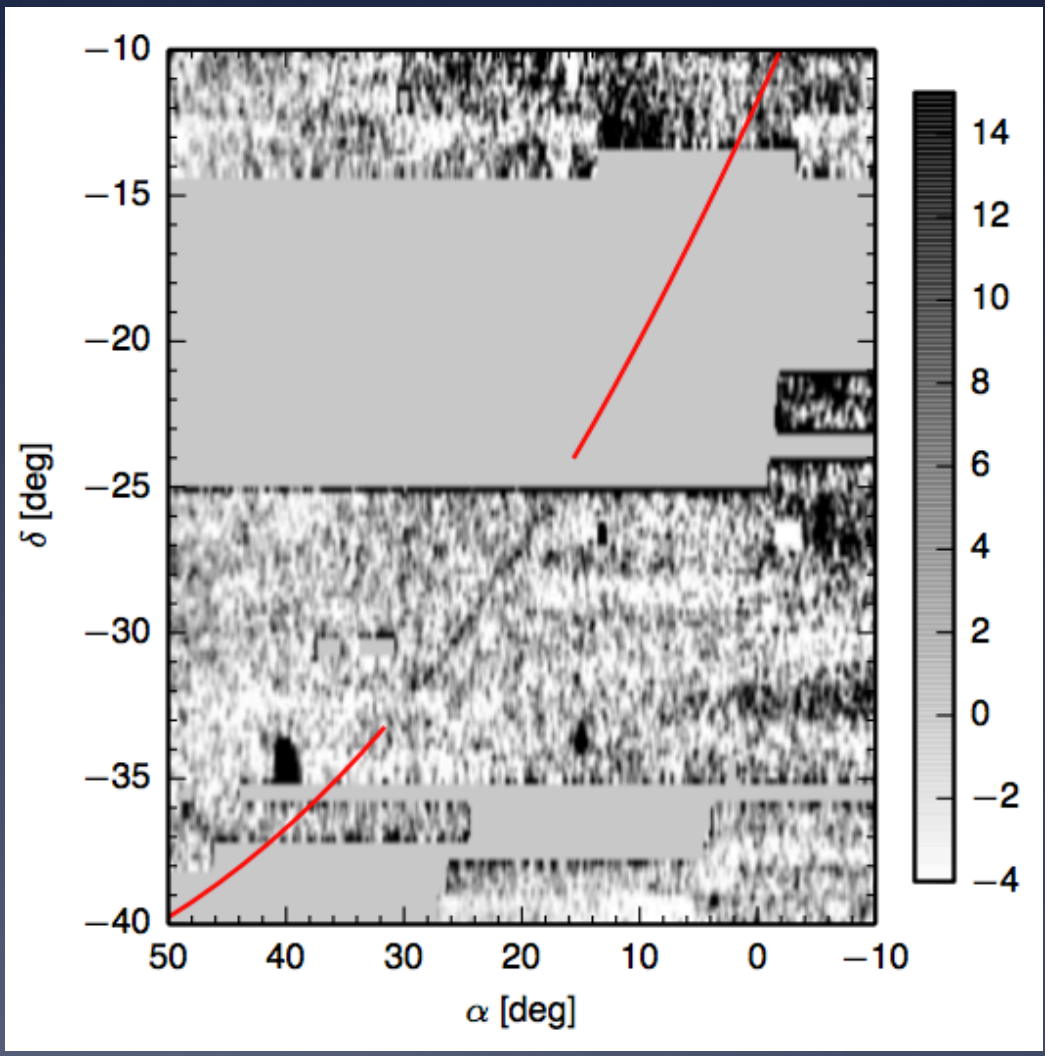
WISE W1

ATLAS Science Goals

- Cosmology
  - 10000 QSO z survey already completed via 2dF
    - pilot for larger survey with e-Rosita+4MOST
  - Integrated Sachs-Wolfe via Luminous Red Galaxies
  - QSO Lensing + galaxy ugrizYJK photo-z
    - +quadruple lenses
  - Galaxy counts – study extent of "Local Hole"
- Other Science
  - Z~7 QSOs via ATLAS+VHS+WISE z dropouts
  - Beyond the Great Attractor + Fornax etc
  - Milky Way satellites + Stellar Streams
  - White Dwarfs via ATLAS and proper motions

Crater dwarf and Cold Stream

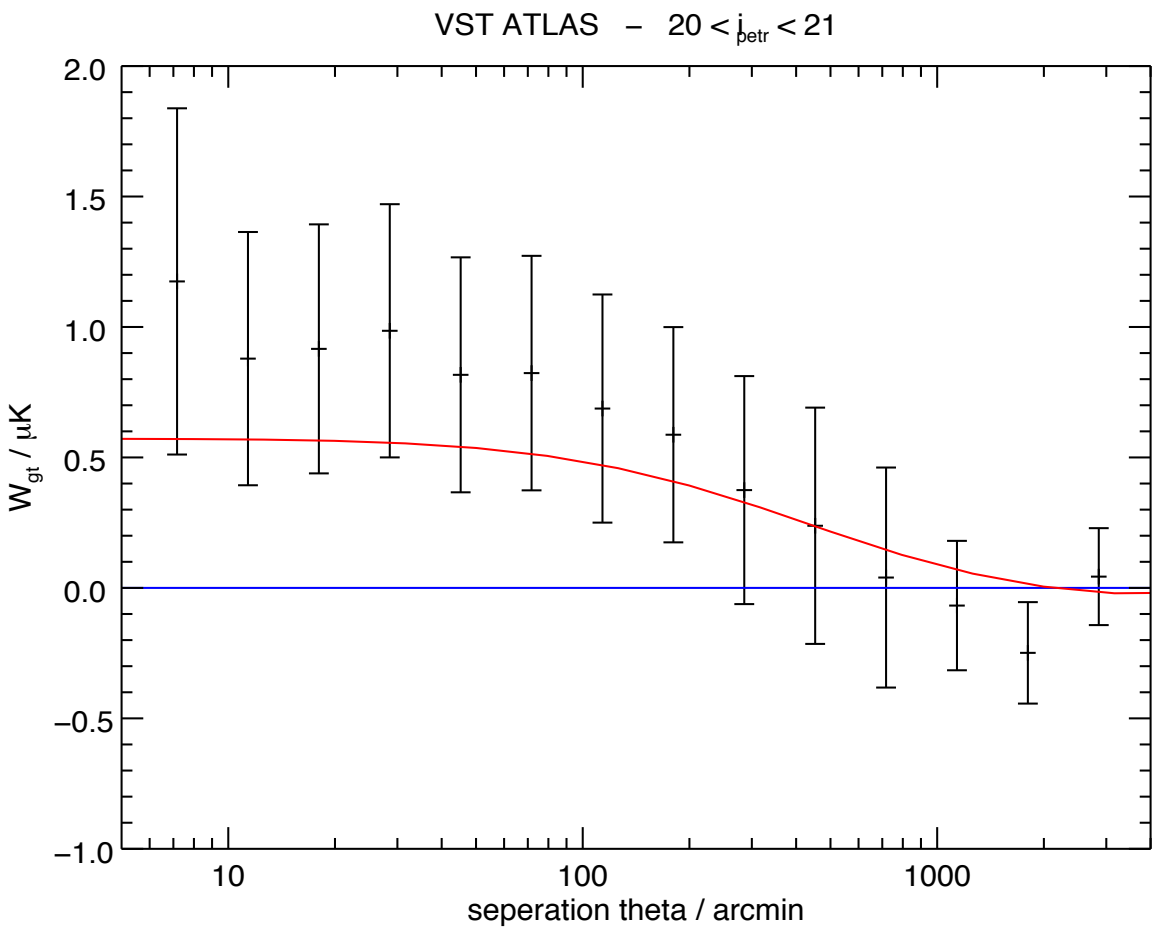




ATLAS gri Crater dwarf (Belokurov et al)

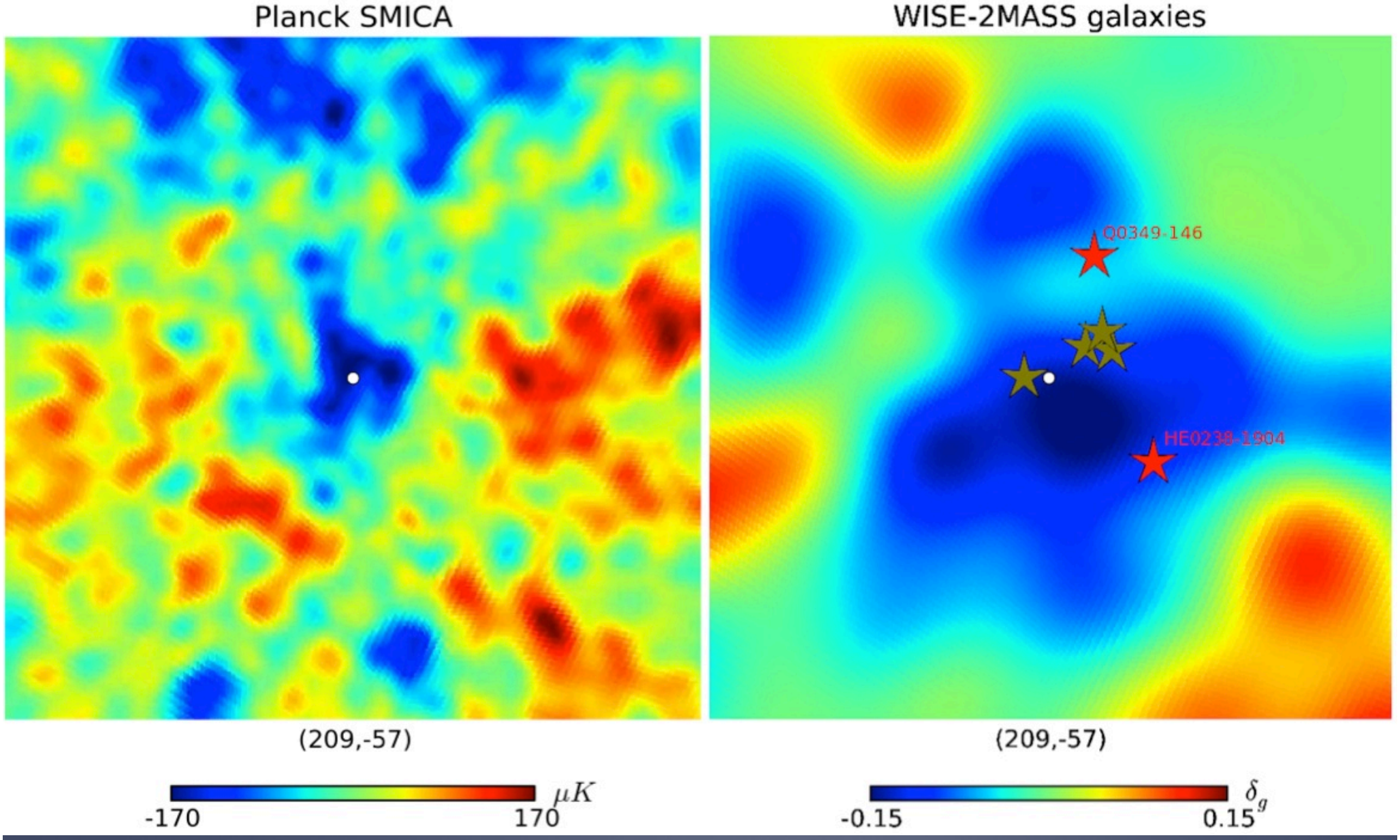
ATLAS Cold Stream (Koposov et al)

Integrated Sachs Wolfe Effect

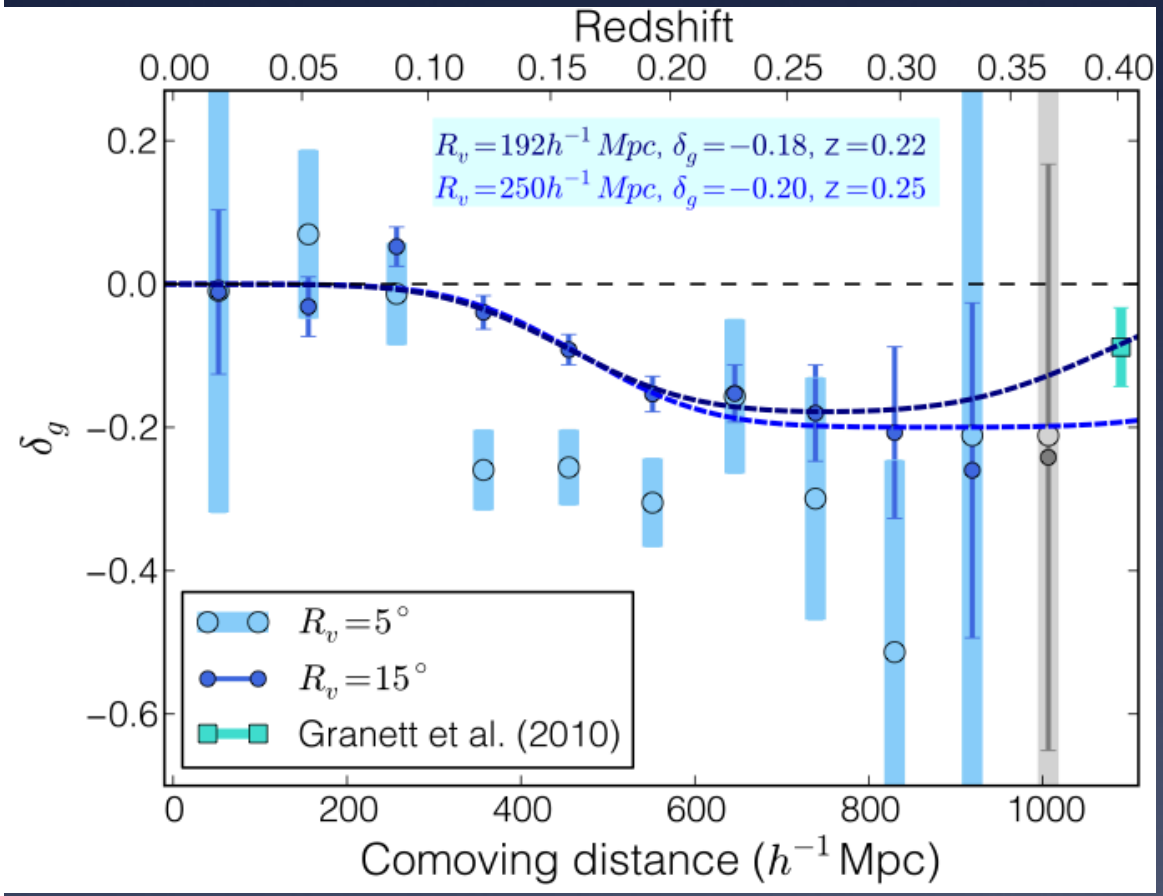


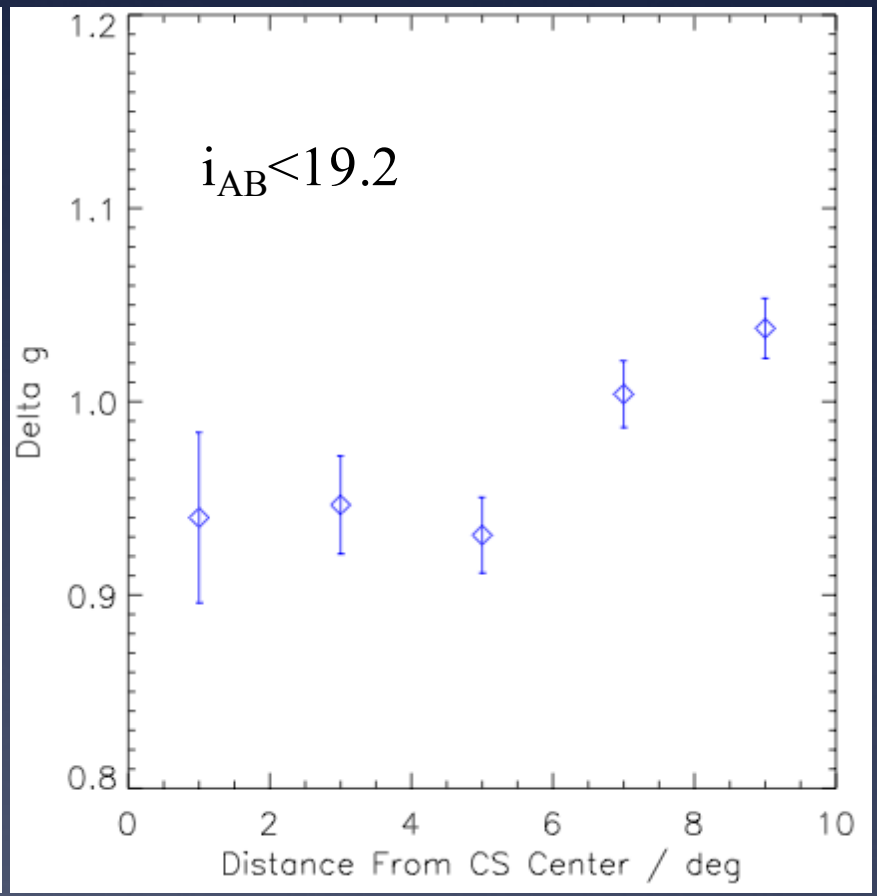
* Cross-correlate Planck and ATLAS galaxies over 3000deg^2
* Preliminary result gives agreement with LCDM for $20<i_{AB}<21$ galaxies

CMB Cold Spot ISW Supervoid



CS void – PS1 photo-z+ATLAS profile

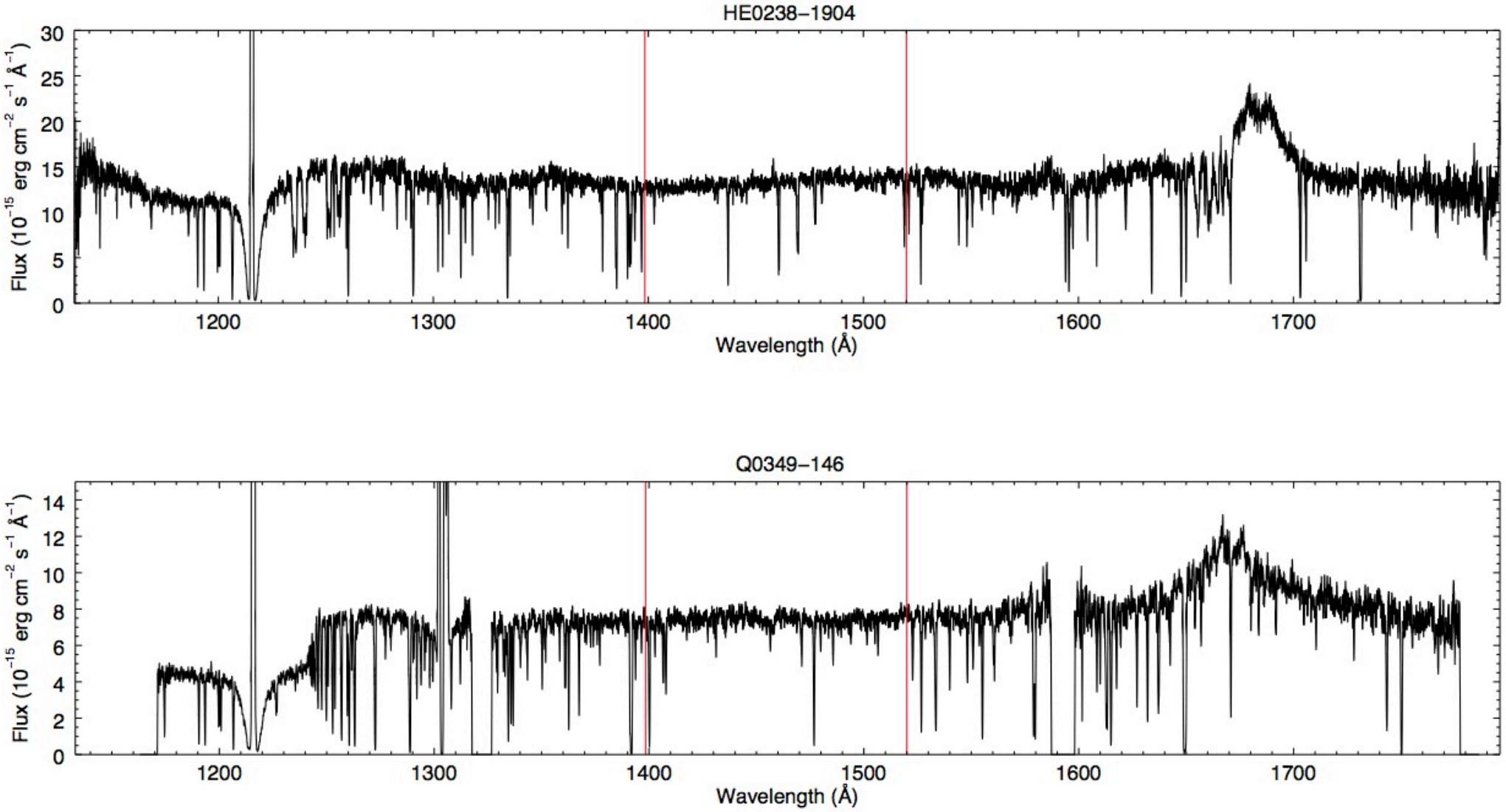




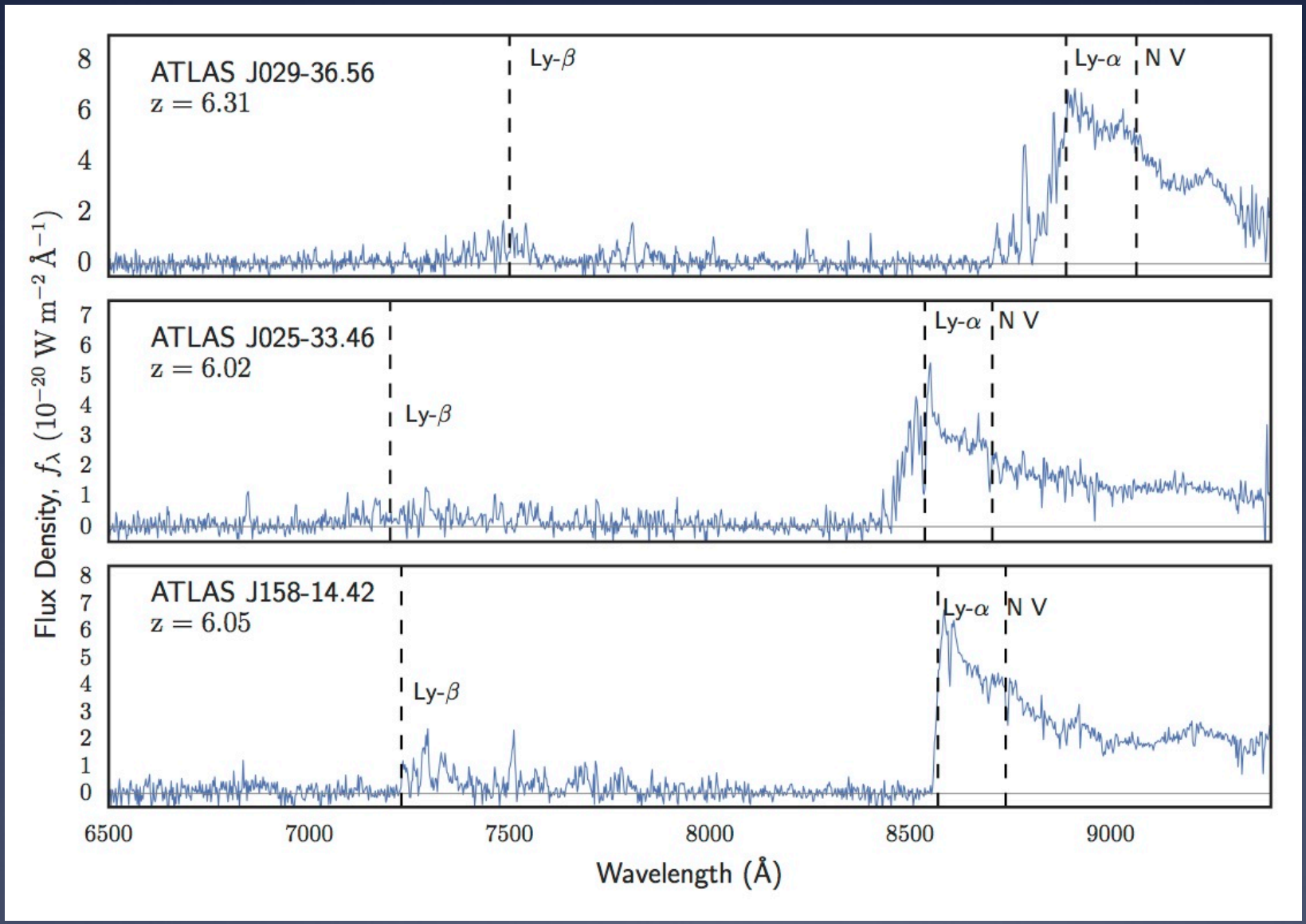
Szapudi et al 2014 – Cold Spot supervoid

ATLAS Cold Spot radial profile

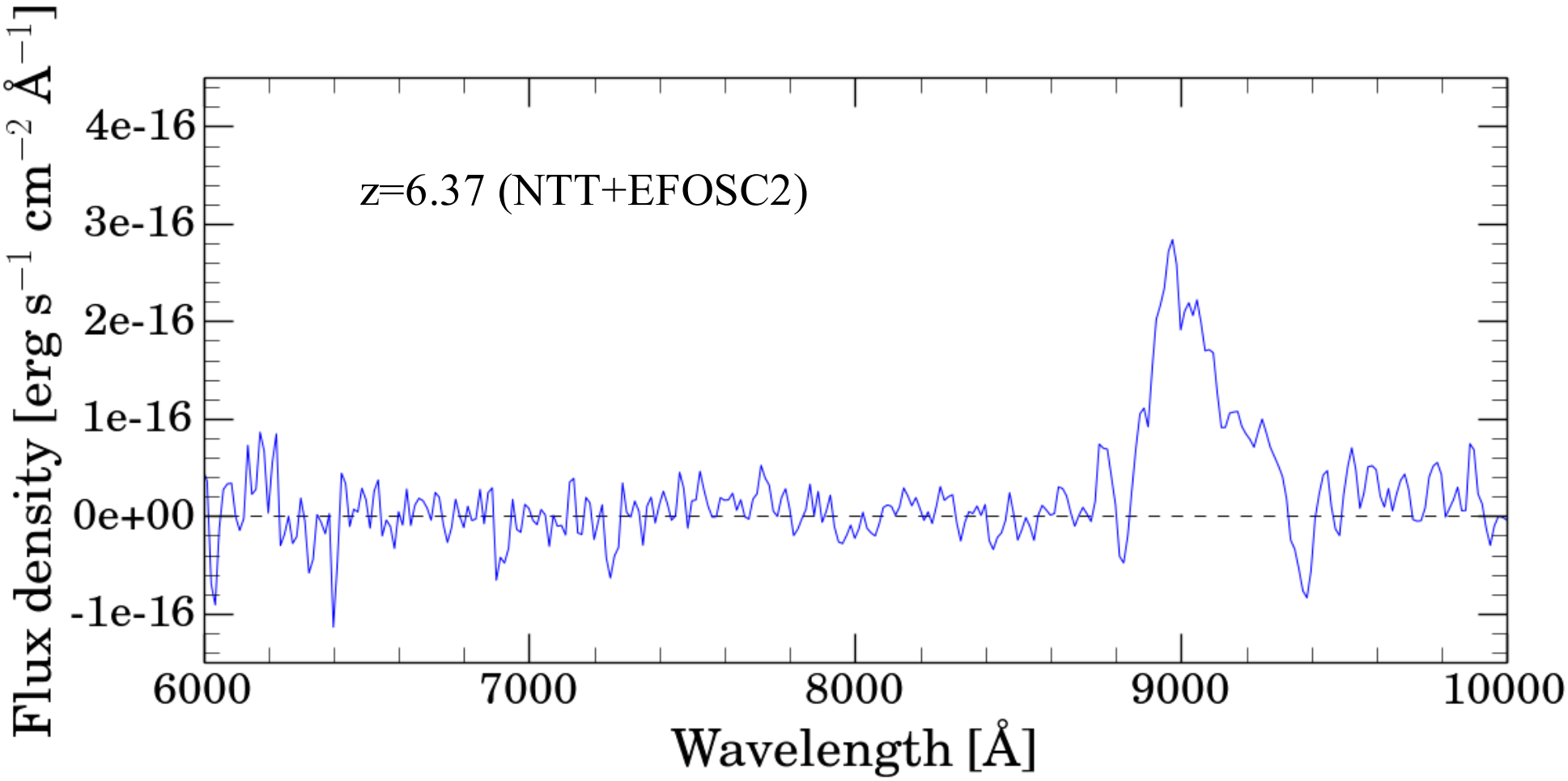
HST COS spectra of 2 CS QSOs



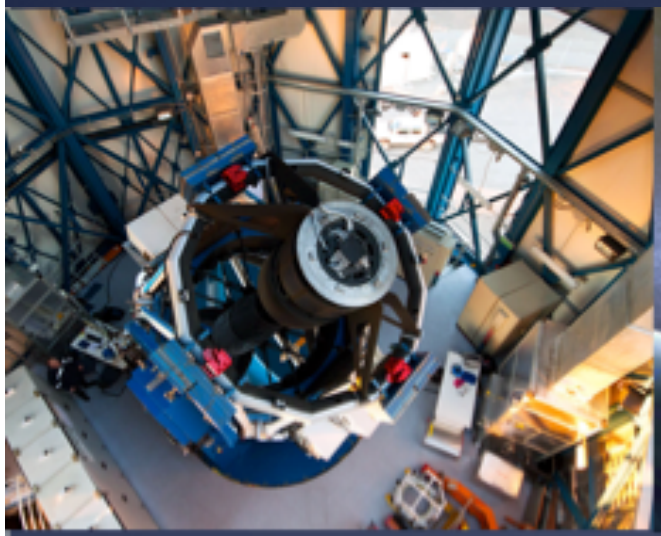
ATLAS+WISE high z quasars



ATLAS+WISE high z quasars



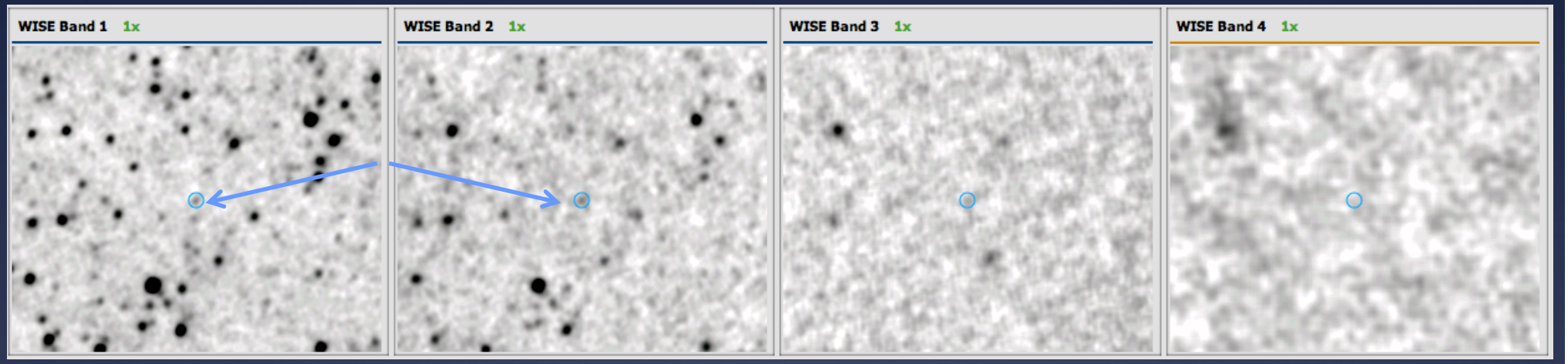
ATLAS+2dF Survey of 10000 quasar redshifts to g=22.5 (2QDES pilot - Chehade et al 2015)



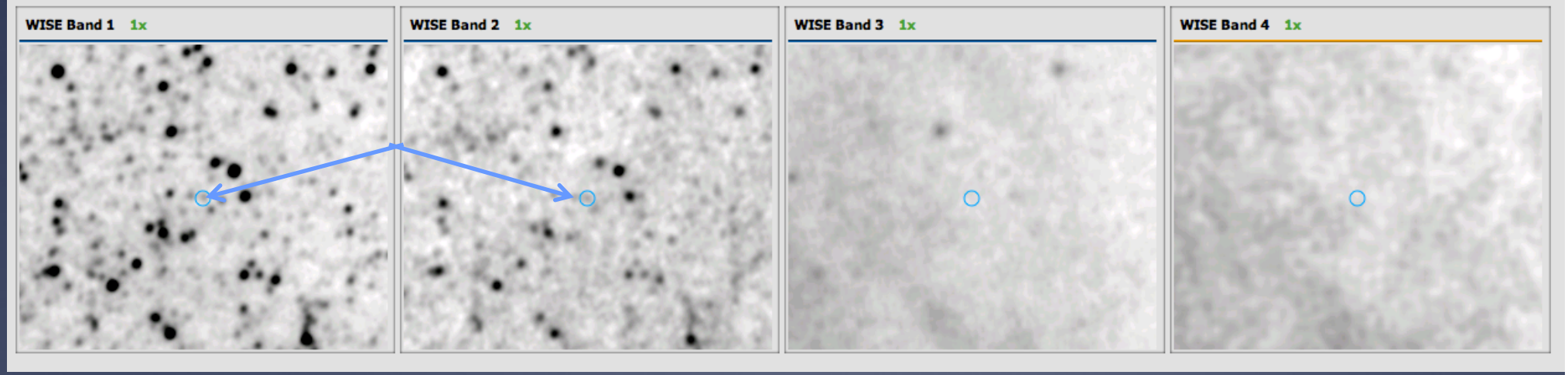
Survey instruments

- → VST ATLAS + WISE + AAT 2dF

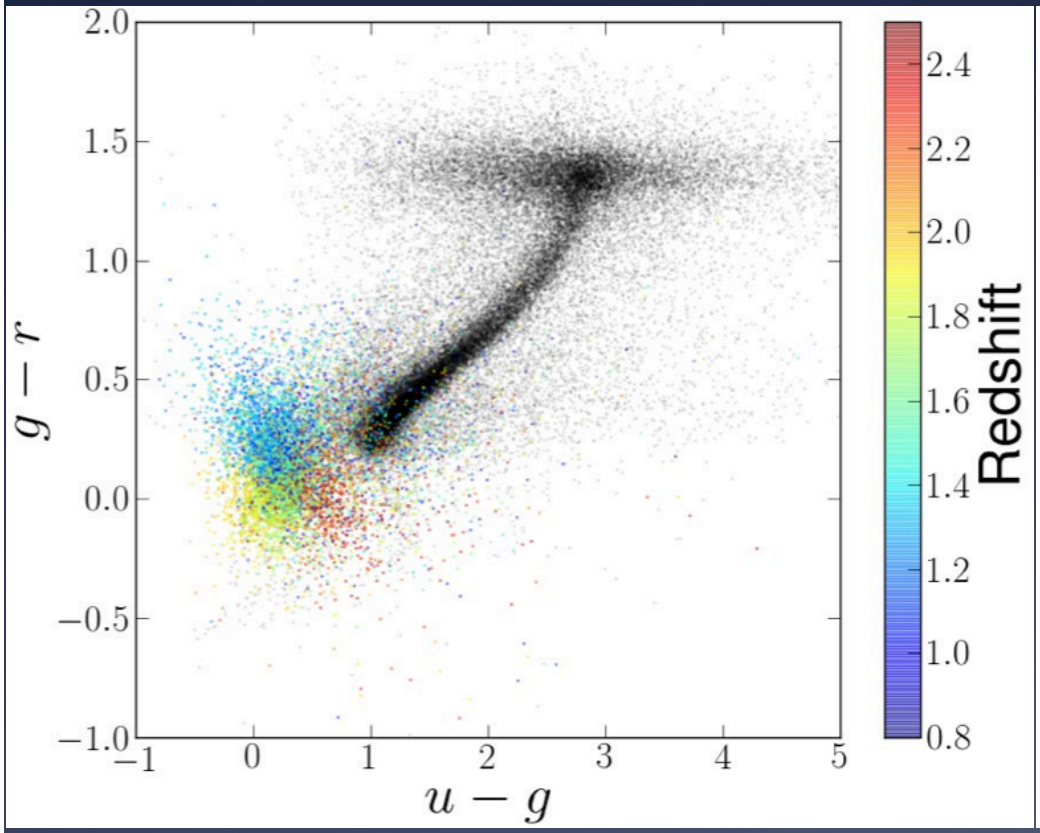
WISE - g~21.5 QSOs at 3.4,4.6 μm

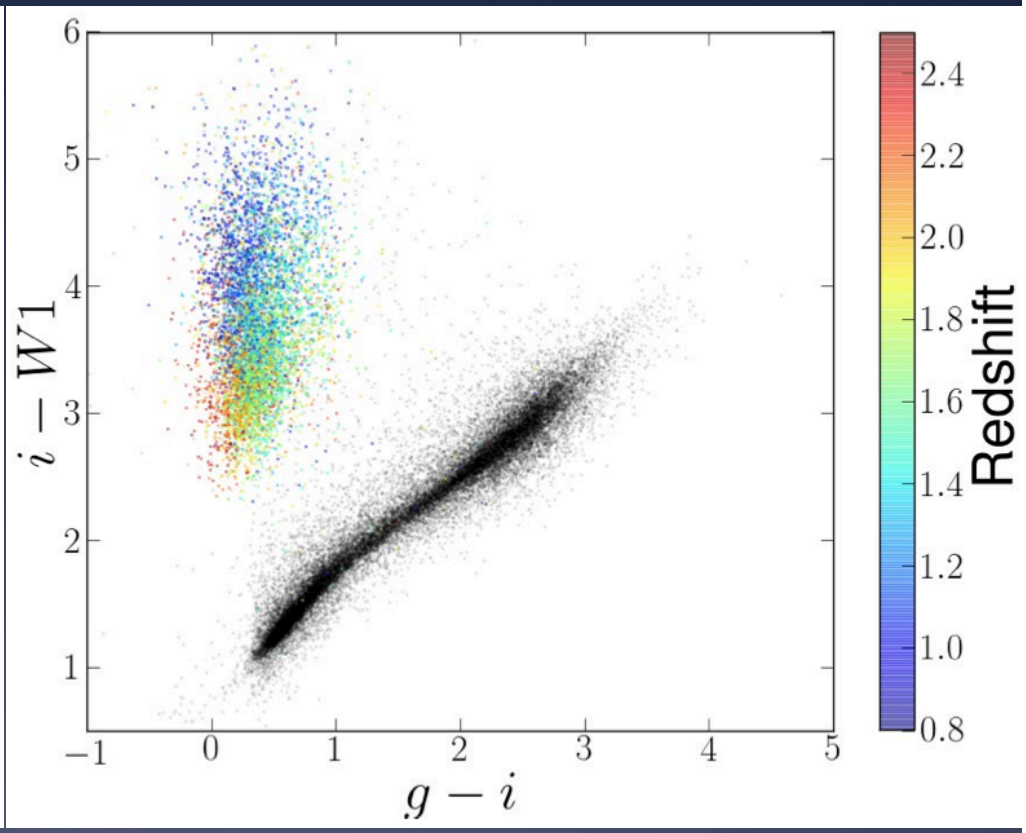


3.4μm 4.6μm 11μm 24μm



Optical+NIR QSO selection

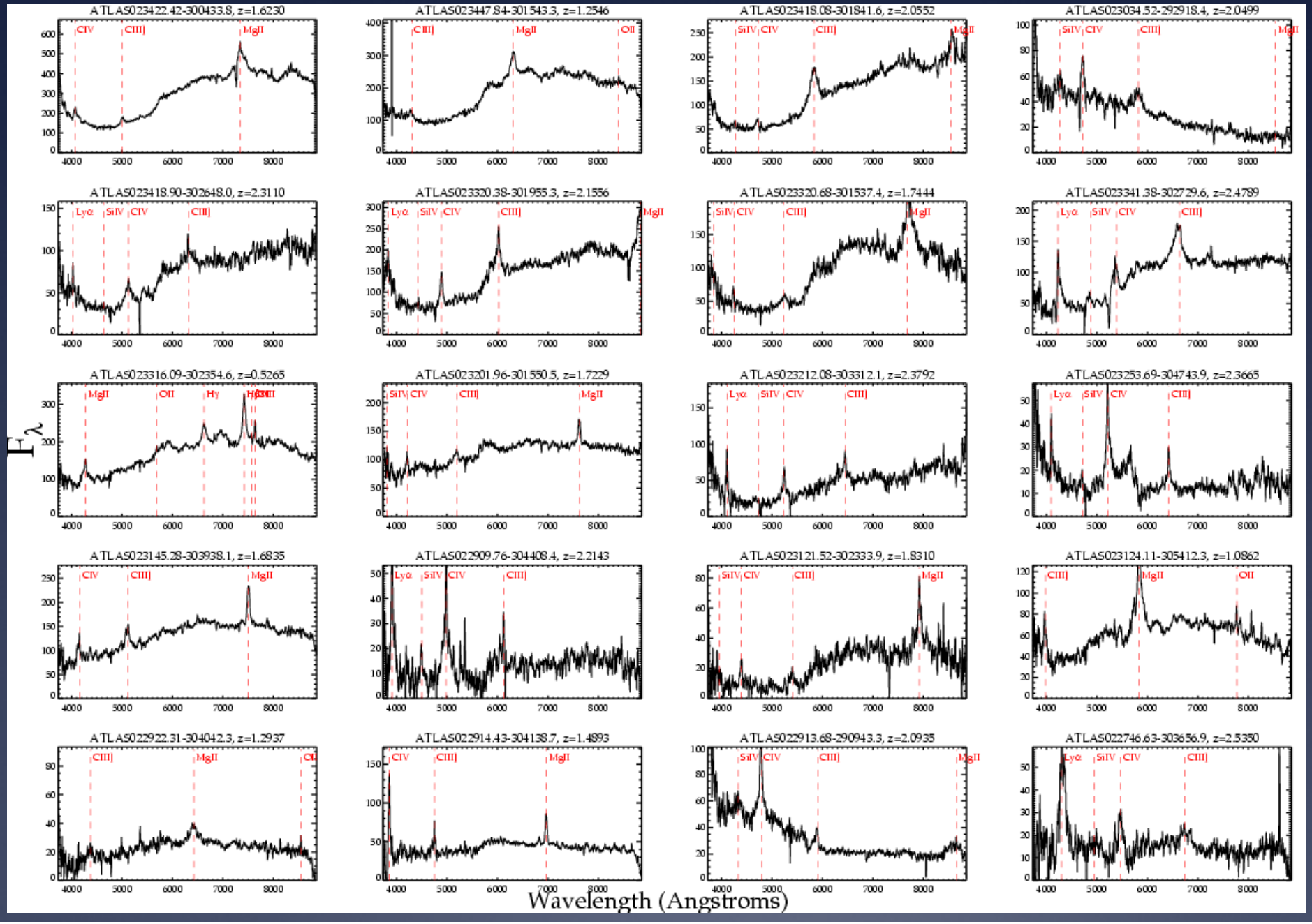




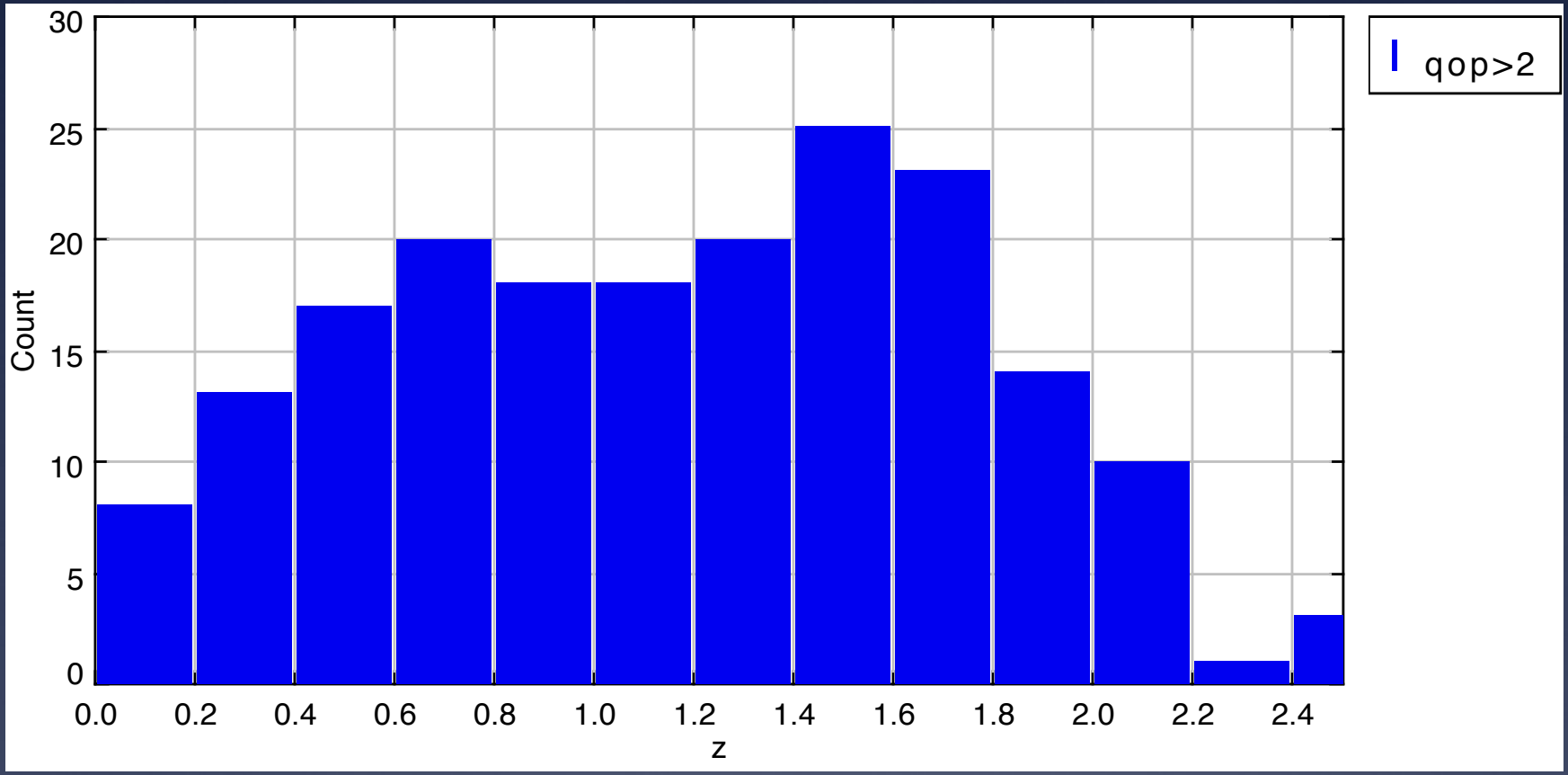
Quasars show ultraviolet and NIR excesses wrt stars

Aim was to get quasar densities in the range 80-100deg^{-2} in ~1hr on 2dF

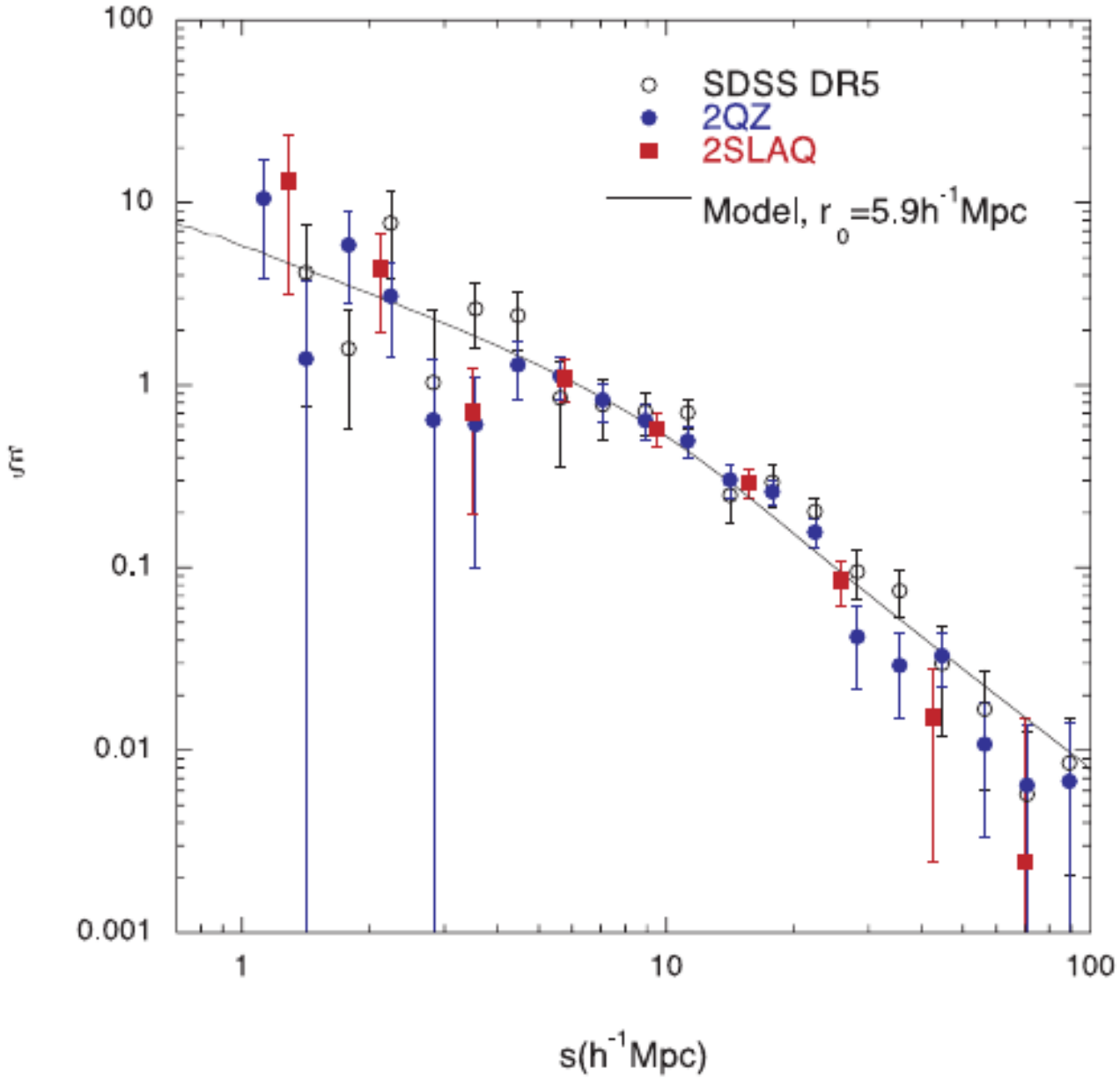
2dF ATLAS QSO Spectra



AAOmega Pilot QSO n(z)



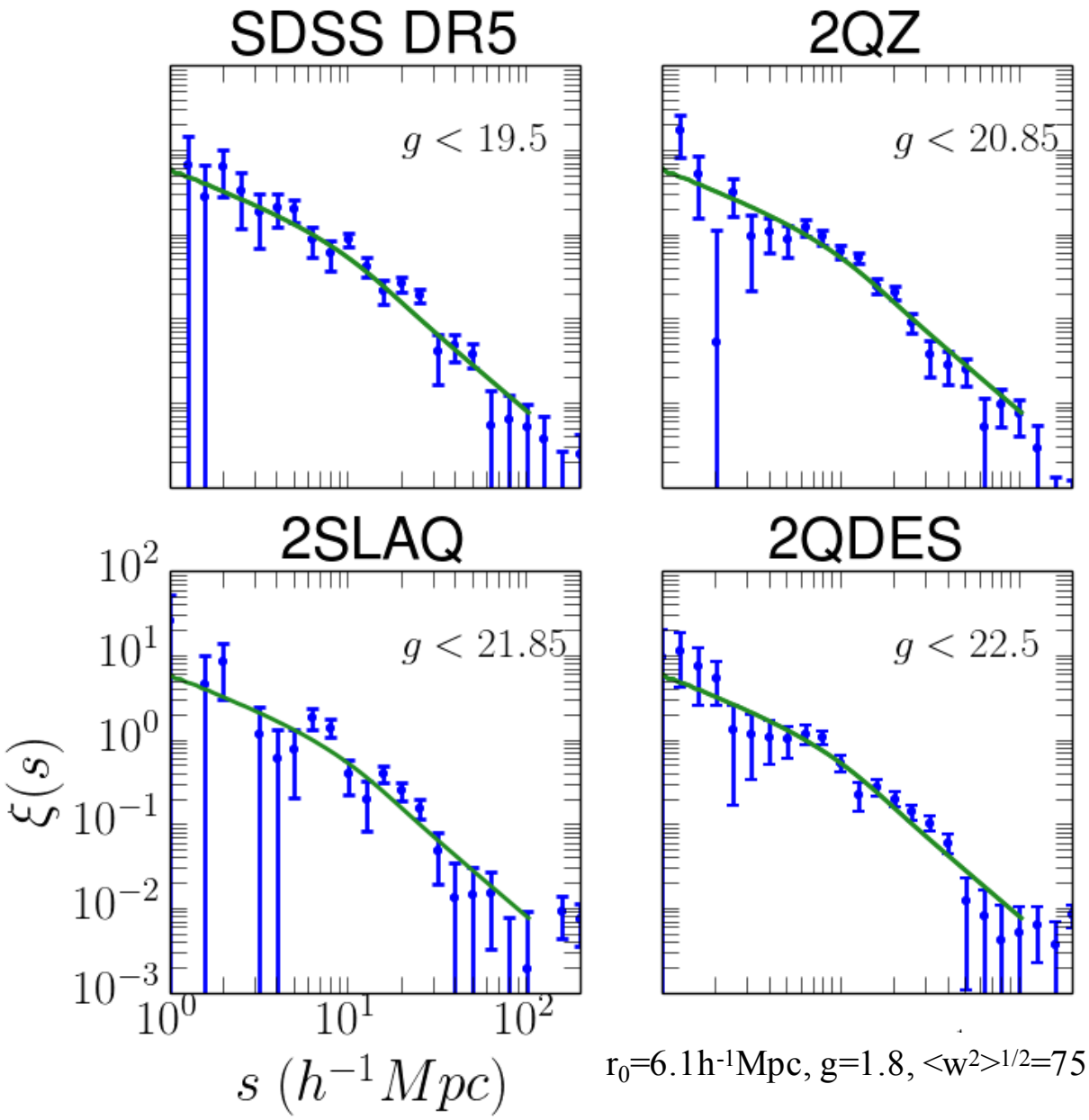
QSO clustering luminosity dependence



* Shanks et al 2011
* SDSS at g~19.5 through 2QZ at g~20.8 to 2SLAQ at g~21.8
* → similar clustering amplitudes for quasars
* Do all quasars have the same halo mass?

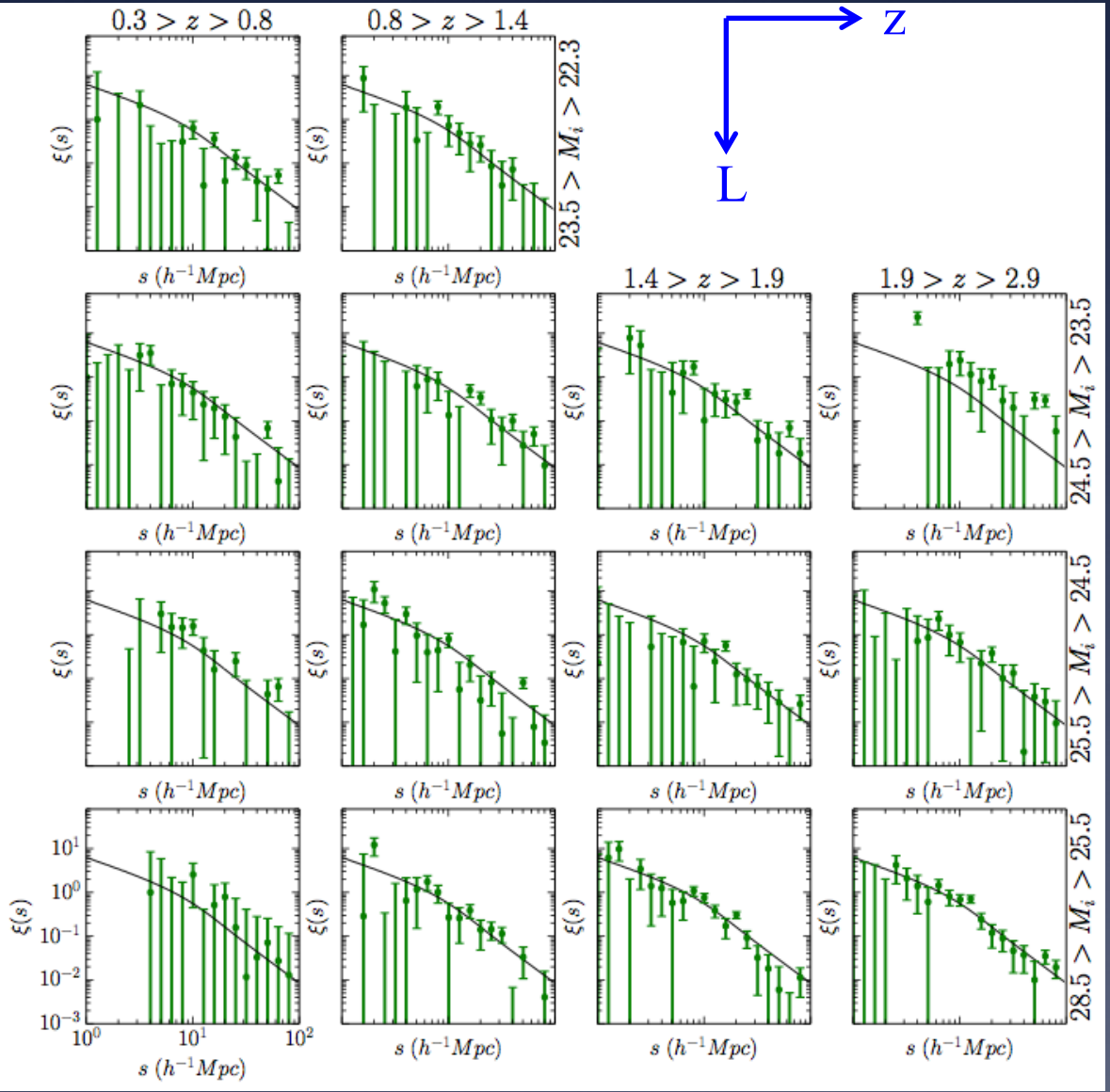
Clustering compared over 10x in luminosity

0.5<z



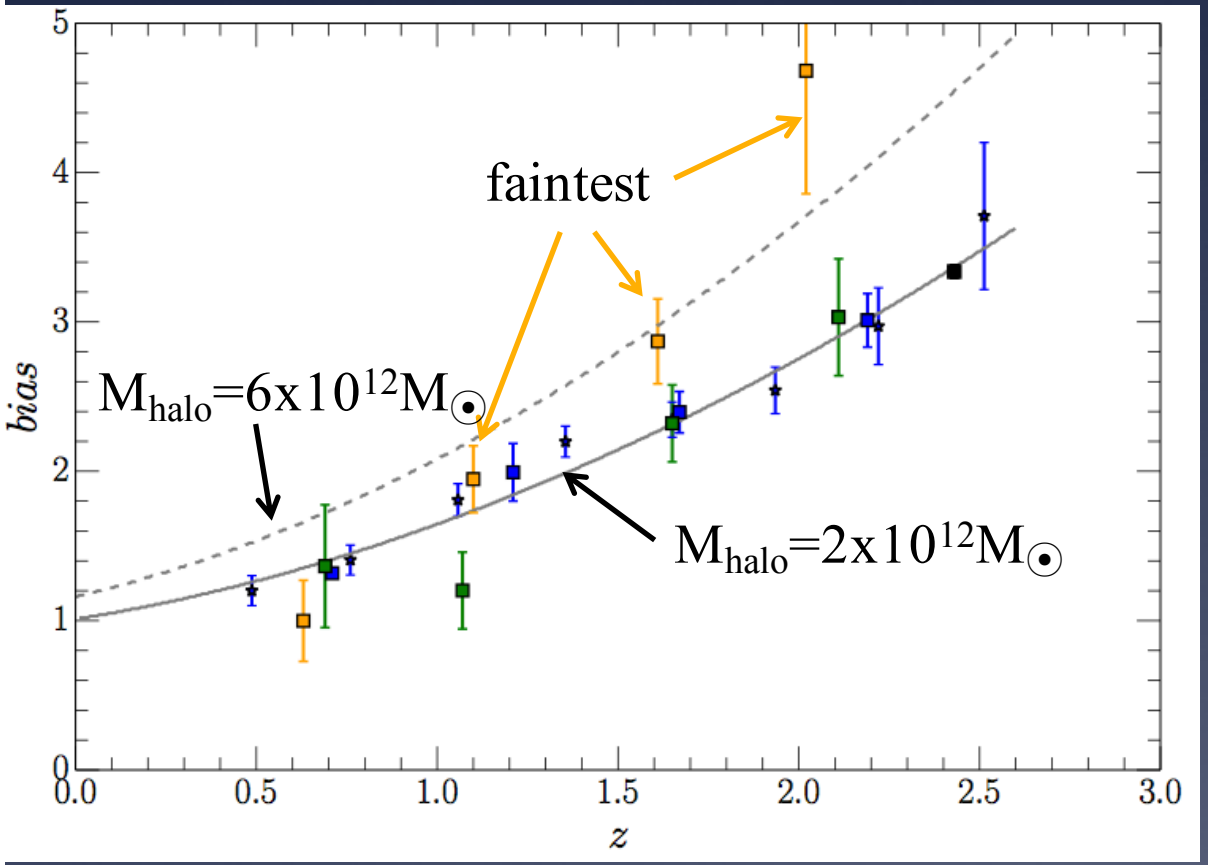
r_0=6.1h^{-1}Mpc, g=1.8, <w^2>$^{1/2}$=750kms^{-1}

QSO clustering vs L, z



- Quasar clustering binned by luminosity and redshift
- Little dependence on either L or z
- ⇒ Quasar halo masses constant at $2 \pm 0.2 \times 10^{12} M_{\odot}$

QSO M_{halo} (and M_{BH}) constant with z

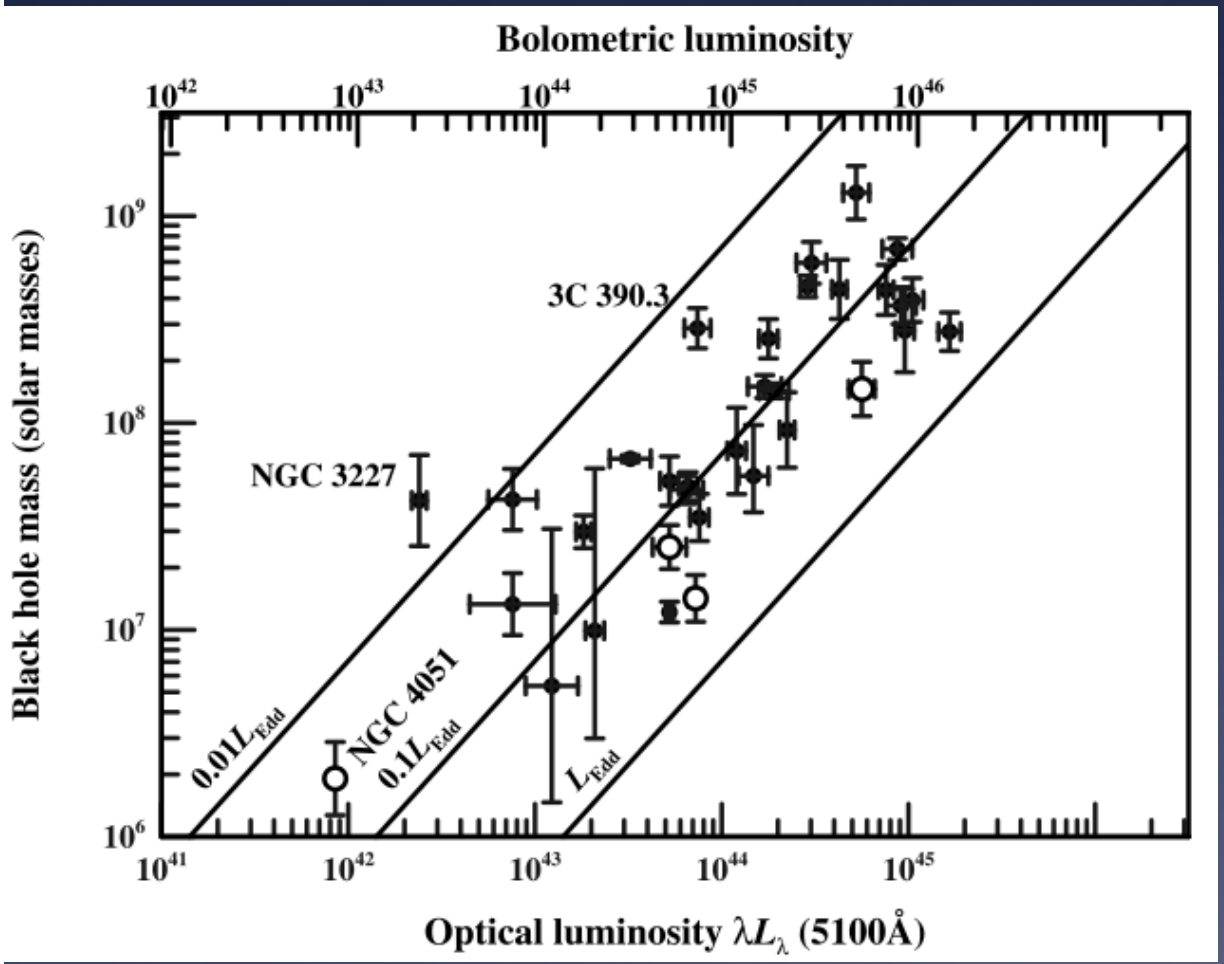


* QSO clustering amplitude well fitted by single halo mass (~$2x10^{12}M_{\odot}$) over wide z range
* ⇒Indeed fainter quasars might be in higher mass haloes!?!

All quasars have the same M_{BH}?

* ⇒clustering strength independent of luminosity
* ⇒quasar host halo mass independent of luminosity
* ⇒quasar black hole mass independent of luminosity
* ⇒all quasars have the same black hole mass?
* ⇒Explain by quasar "flickering" model?

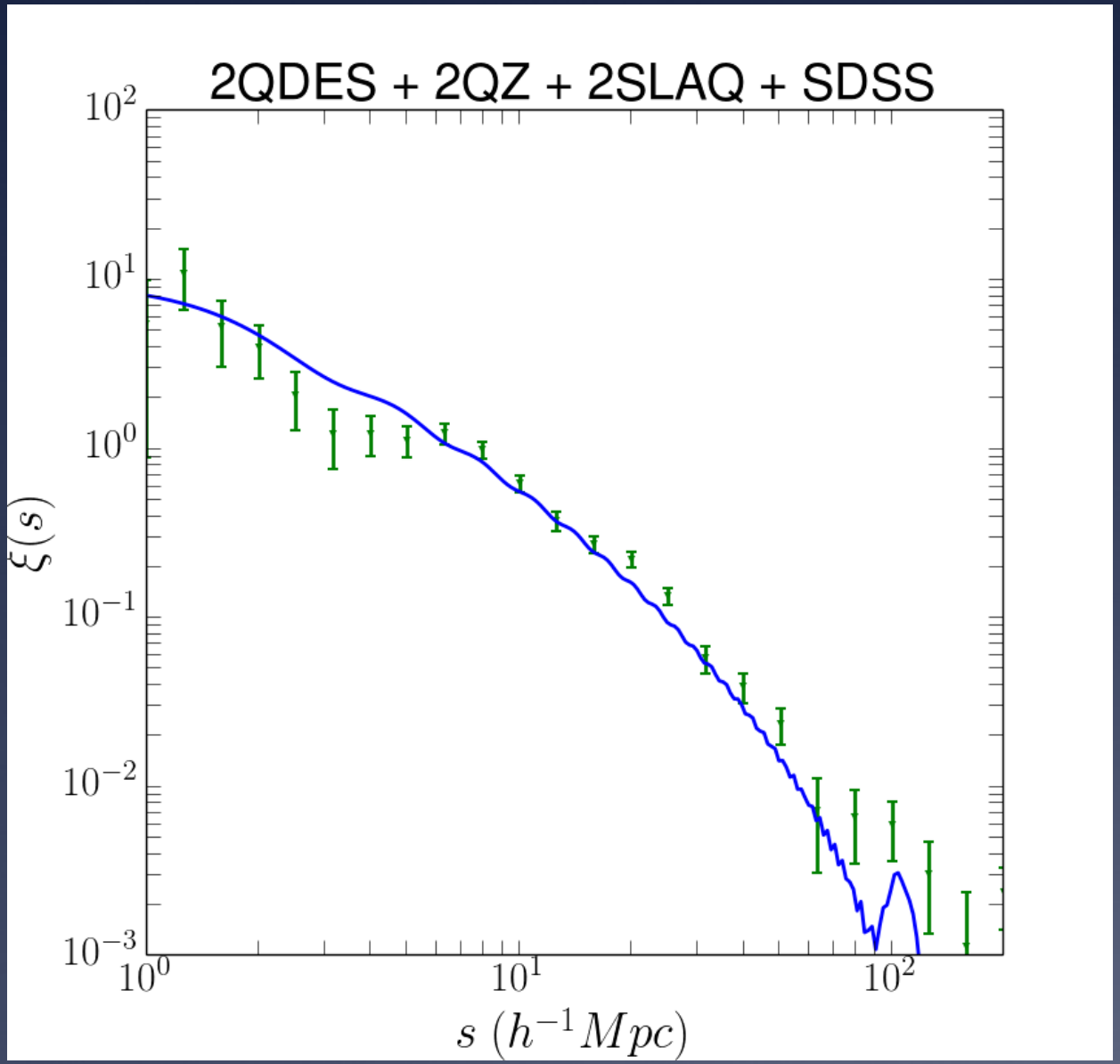
Reverberation mapping



Peterson et al 2004

* But "flickering" or any other model that explains clustering result
* → contradicts M_{BH} - L relation
* Have to break $M_{BH} \sim M_{halo}^{1.8}$ relation

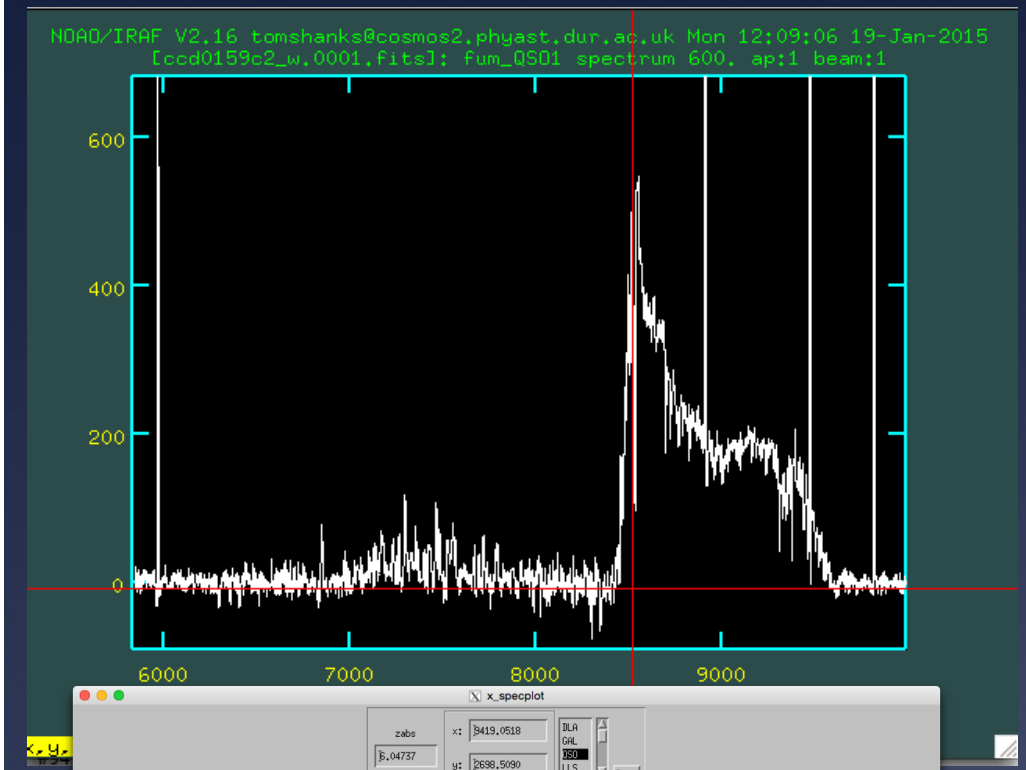
Large scale quasar clustering



* ~85000 SDSS + 2QZ+2SLAQ+2dF/ATLAS quasars at 0.5<z<2.5
* Little evidence of any BAO peak
* Too small effective volume? ~0.2 Gpc^3
* Need 4MOST over 7500deg^2 @100deg^{-2} to beat eBOSS

Conclusions

- VST ATLAS ~4000/4700deg^2 completed (+1500deg^2 Chilean u)
- Sub-arcsecond seeing available in most fields
- VHS/WISE already covers half/full ATLAS area
- Highlights so far
  - New MW dwarf galaxy and stellar stream discovered
  - Preliminary detection of ISW effect using field galaxies
  - 4 z>6 quasars found by combining ATLAS+WISE
  - A survey of ~10000 faint quasars completed
  - Quasar clustering amplitude independent of luminosity
- Larger z survey needed to detect BAO – 4MOST on VISTA?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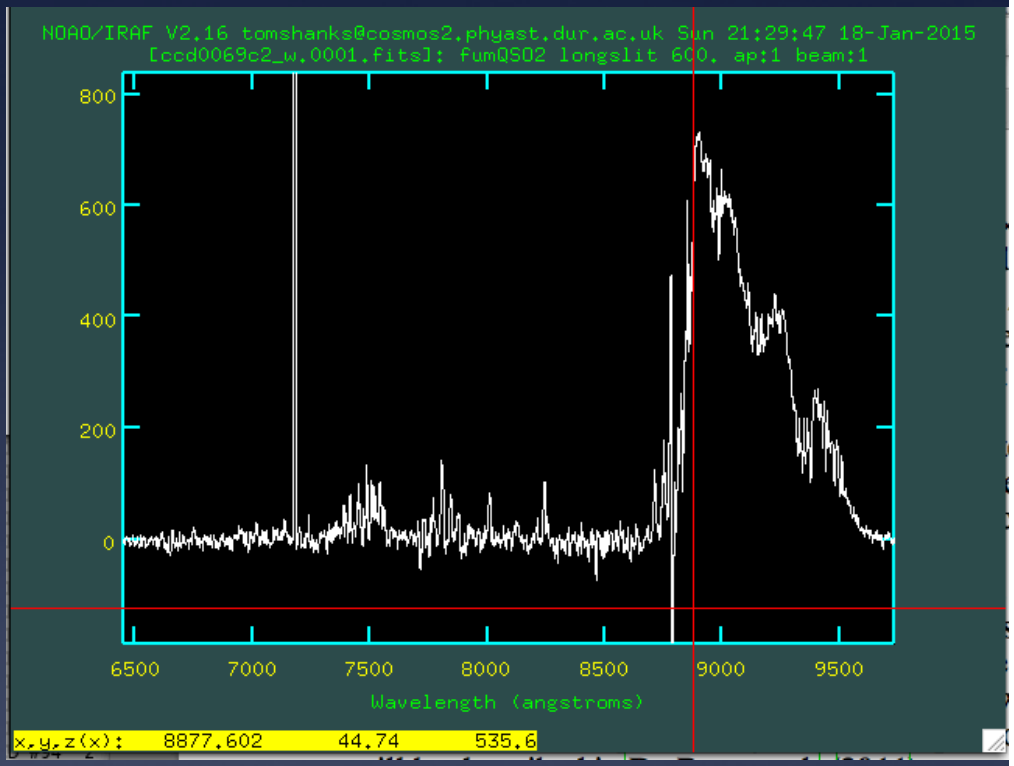
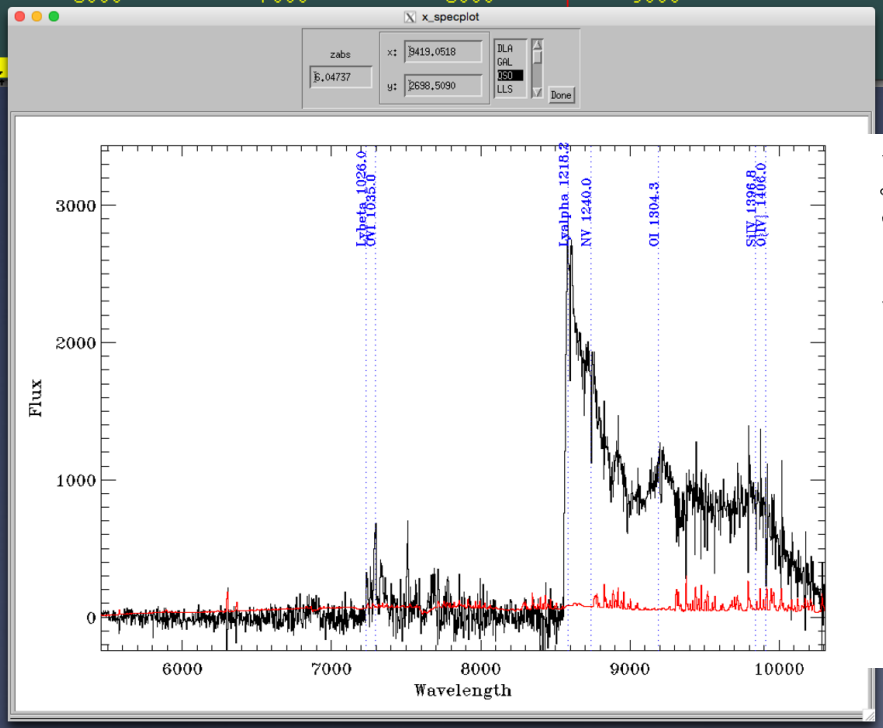
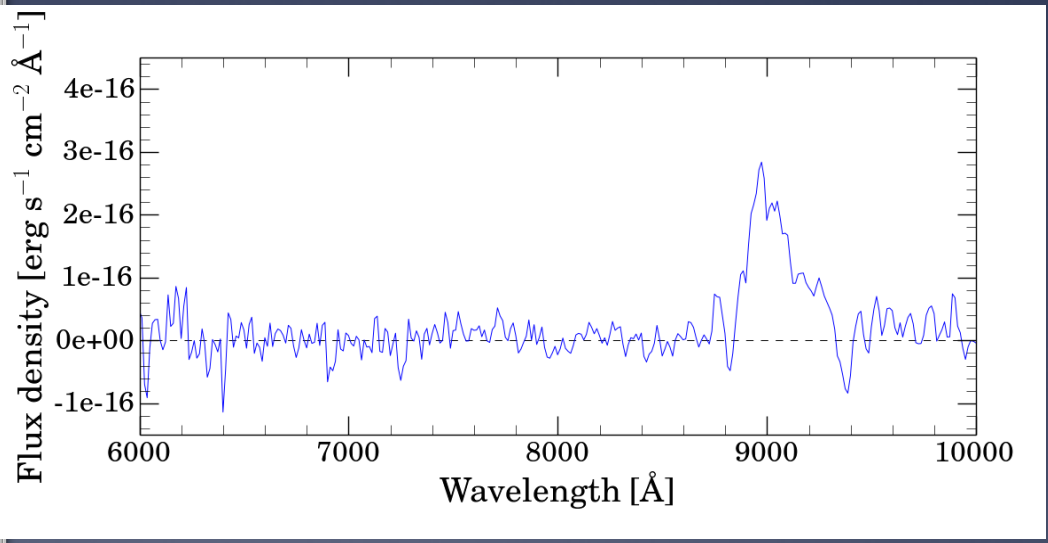
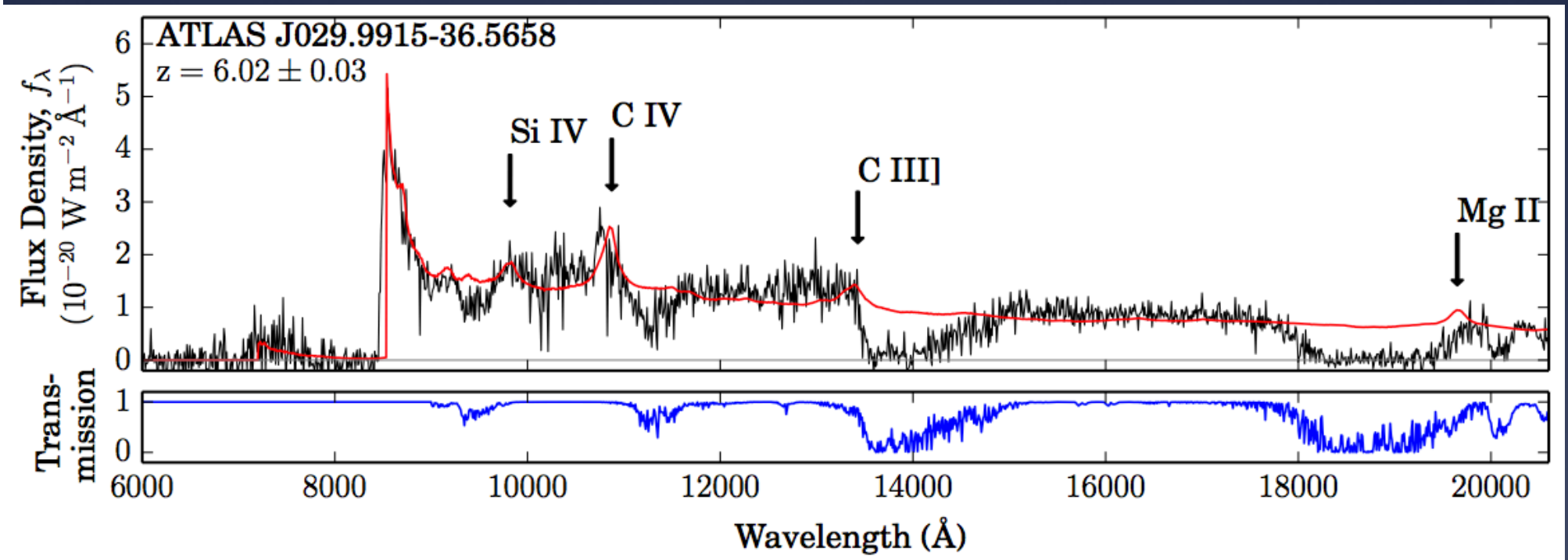

NOAO/IRAF V2.16 tomshanks@cosmos2.phyast.dur.ac.uk Sun 21:29:47 18-Jan-2015
[ccd0069c2_w.0001.fits]: fumQSO2 longslit 600. ap:1 beam:1
800
600
400
200
0
6500
7000
7500
8000
8500
9000
9500
Wavelength (angstroms)
x,y,z(x): 8877.602 44.74 535.6

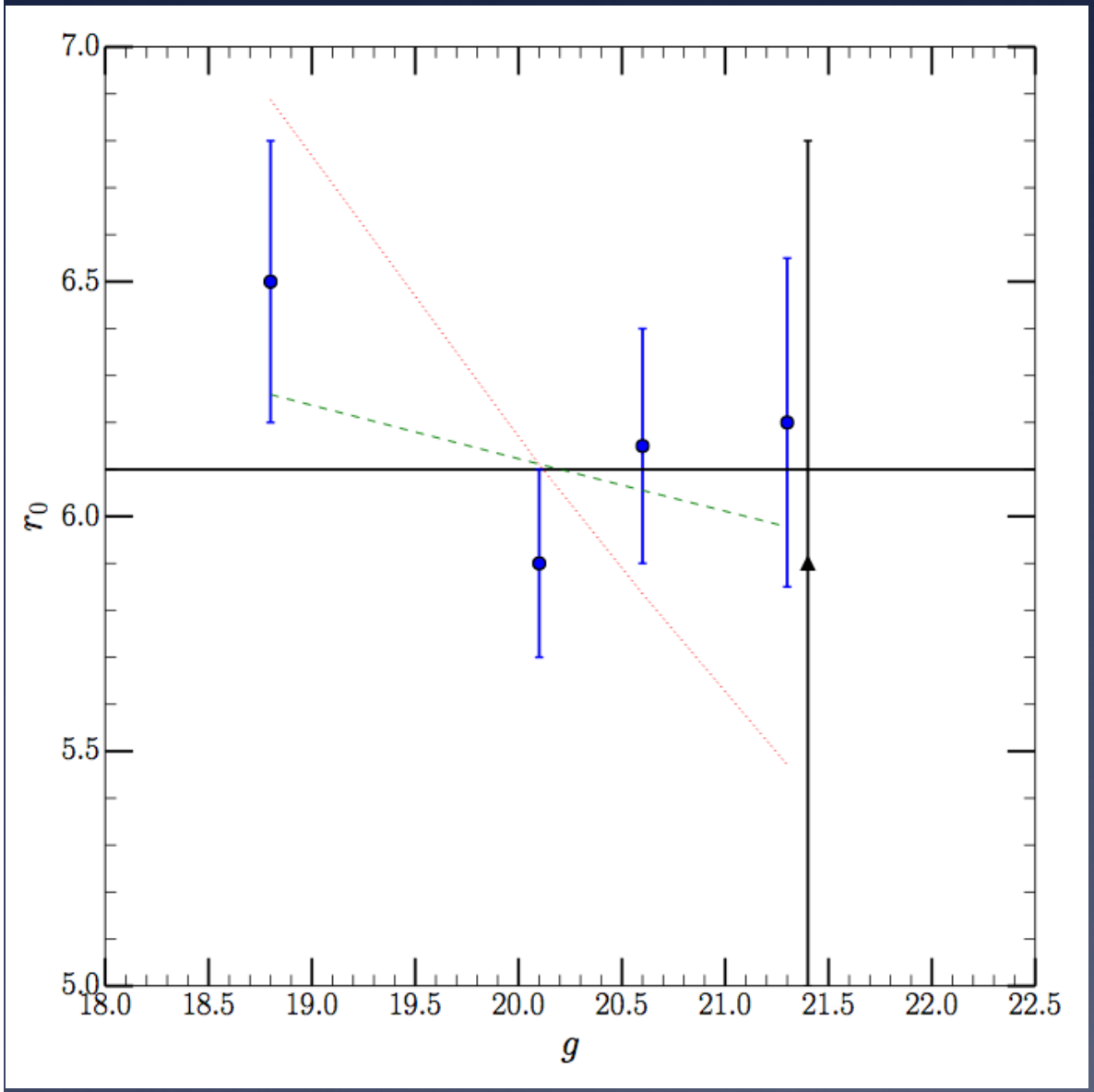

x_specplot
zabs
6.04737
x: 8419.0518
y: 2698.5090
DLA
GAL
QSO
LLS
Done
3000
2000
1000
0
Flux
LyBeta 1026.0
OVI 1035.0
Lyalpha 1216.2
NV 1240.0
OI 1304.3
SiIV 1398.8
CIV 1406.0
6000
7000
8000
9000
10000
Wavelength


4e-16
3e-16
2e-16
1e-16
0e+00
-1e-16
Flux density [erg s^{-1} cm^{-2} Å^{-1}]
6000
7000
8000
9000
10000
Wavelength [Å]

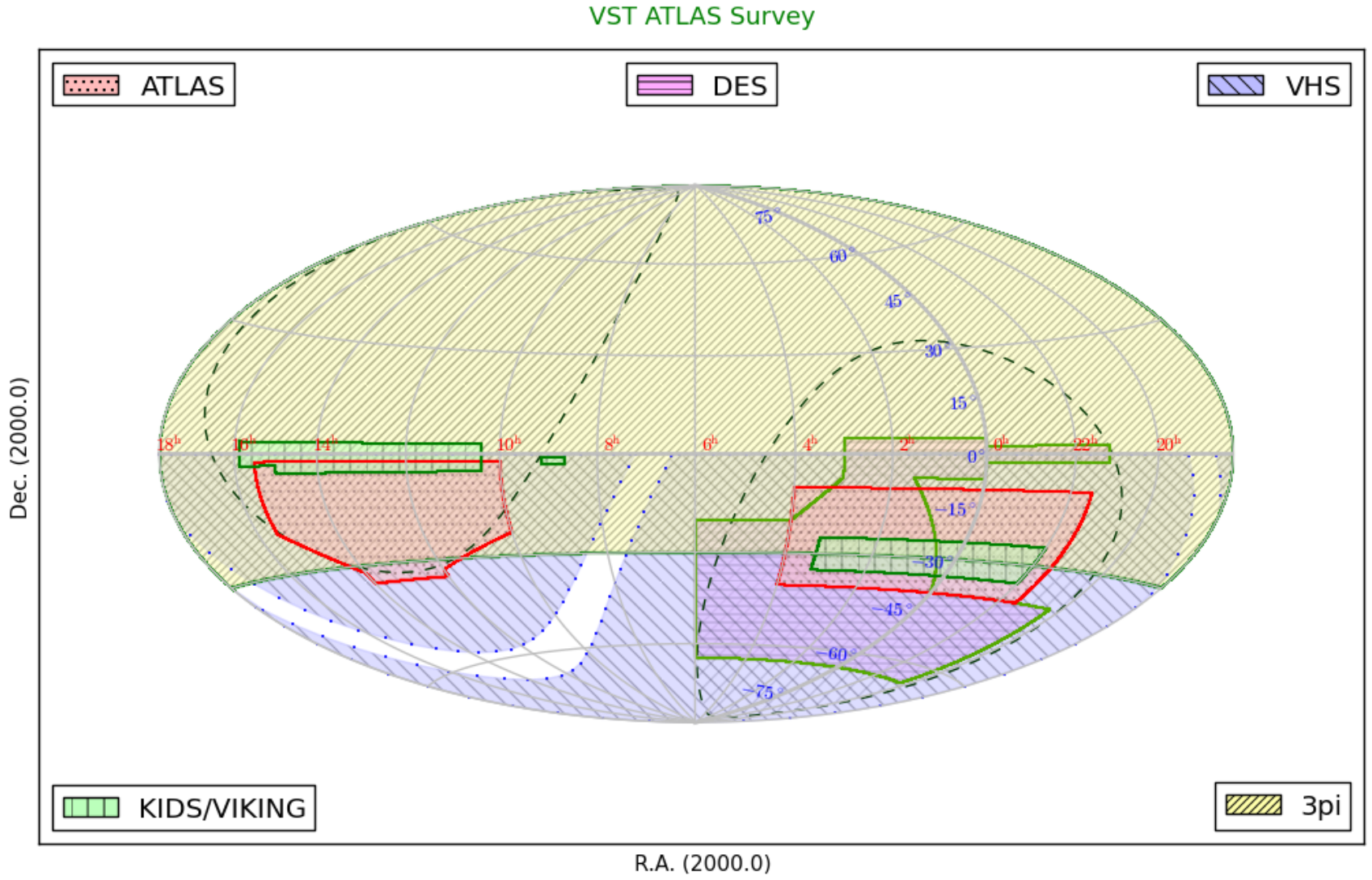
X-shooter VIS/NIR spectrum



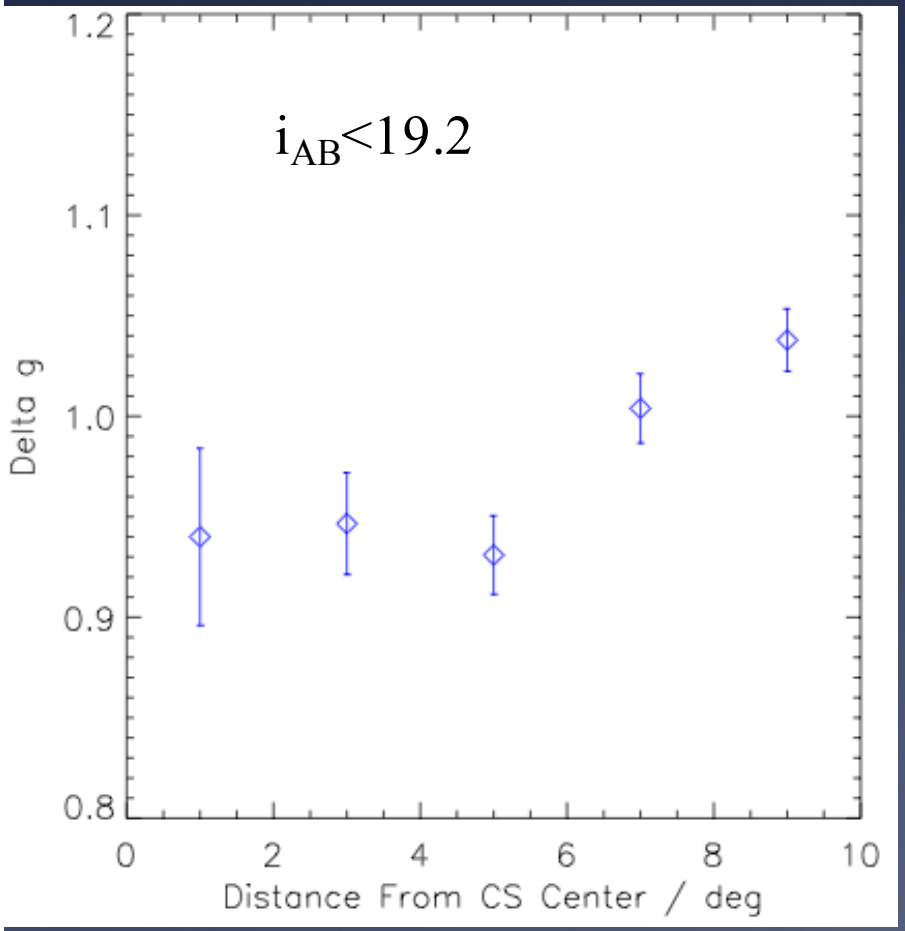
QSO clustering: r_0 versus g

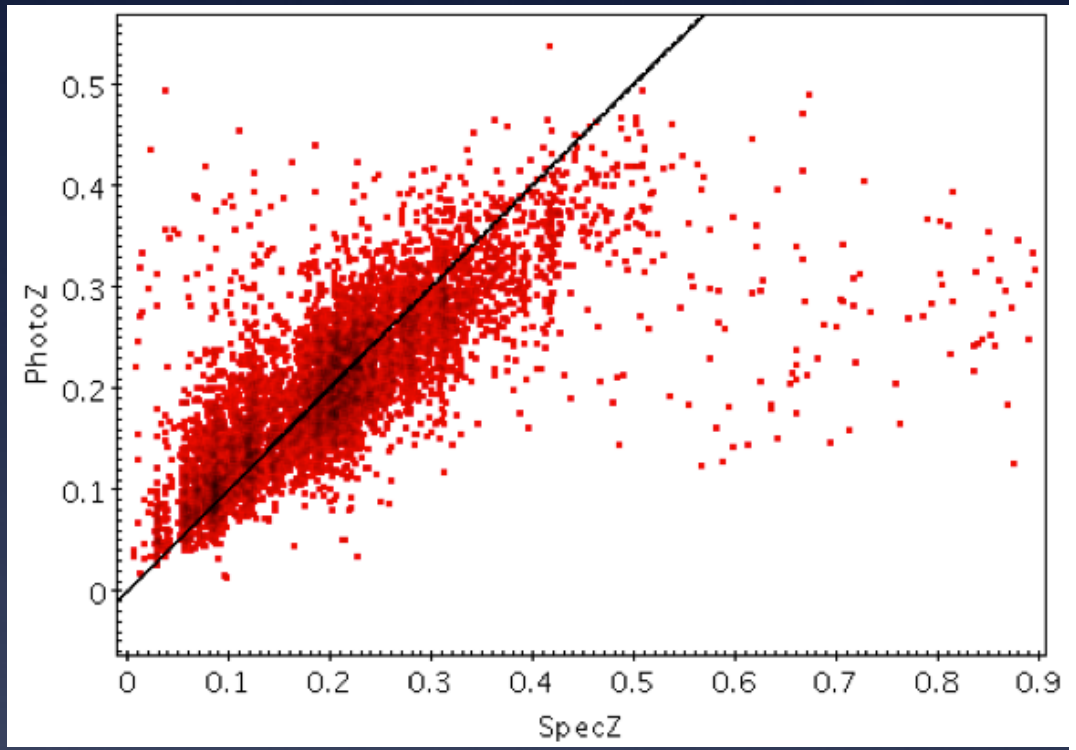


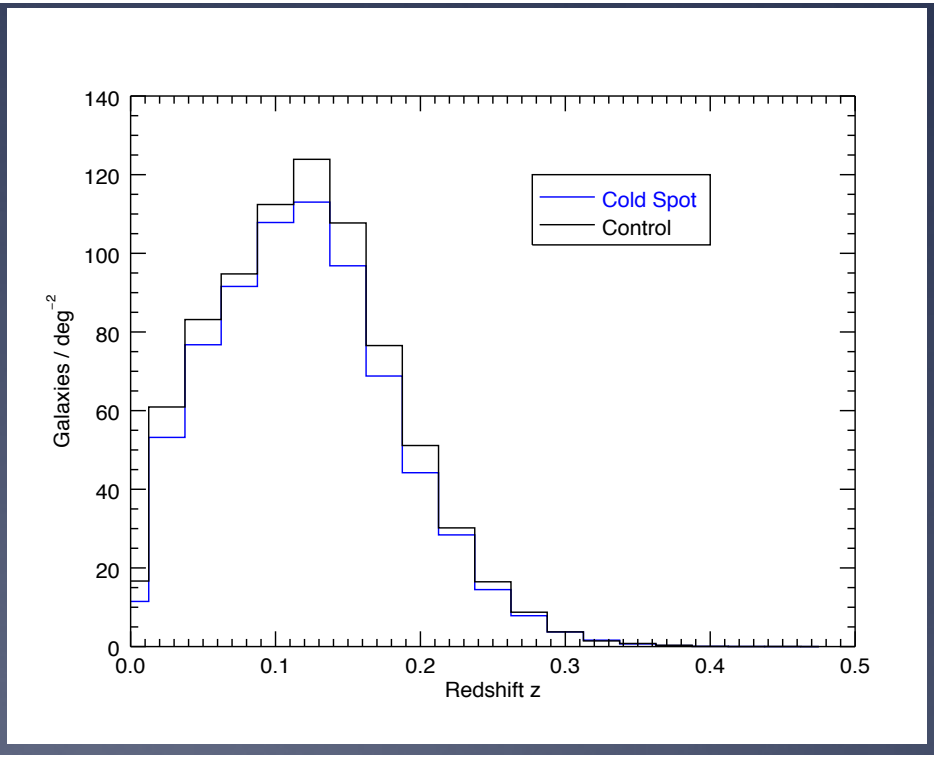
- Quasar clustering binned by luminosity and redshift
- Little dependence on either L or z
- ⇒ Quasar halo masses fixed at $3.5 \pm 1 \times 10^{12} M_{\odot}$


VST ATLAS Survey
ATLAS
DES
VHS
KIDS/VIKING
3pi
Dec. (2000.0)
R.A. (2000.0)
75°
60°
45°
30°
15°
0°
−15°
−30°
−45°
−60°
−75°
18h
16h
14h
12h
10h
8h
6h
4h
2h
0h
22h
20h

ATLAS CS profile+photo-z







White Dwarfs - ugr+proper motions (R. Raddi et al)